T1 *[154 marks]*

1. *[1 mark]*

Markscheme
B

Examiners report
[N/A]

2. *[1 mark]*

Markscheme
A

Examiners report
[N/A]

3. *[1 mark]*

Markscheme
D

Examiners report
[N/A]

4. *[1 mark]*

Markscheme
C

Examiners report
[N/A]

5. *[1 mark]*

Markscheme
A

Examiners report
[N/A]

6a. *[4 marks]*

Markscheme

(i) $R_0 = -1.6(-1.5632)\text{cm}^3\,\text{s}^{-1}$;

(ii) it is negative / this would mean water running uphill / gaining potential energy / *OWTTE*;

(iii) an answer consistent with candidate's value;

(iv) should be 2 significant figures (in line with data values);

Examiners report

[N/A]

6b. *[4 marks]*

Markscheme

% uncertainty in $t = 1\%$;
% uncertainty in V (= 5 + 1)=6% ***or*** % uncertainty in V (= 5 − 1) = 4%;
V (= 2.1 100) = 210 (units);

absolute uncertainty (= 210 × 6%) = 12.6 / 13 / 10 (units) ***or*** absolute uncertainty (= 210 × 4%) = 8.4 / 8 (units);

Examiners report

[N/A]

7. *[2 marks]*

Markscheme

fractional uncertainty in $l = \frac{1}{880}$ ***or*** 0.00114
<u>and</u> fractional uncertainty in $T = \frac{1}{19}$ ***or*** 0.0526;
(both needed)
(accept percentage, or fraction here – allow candidate to quote $\frac{2}{19}$ *directly if added correctly later)*

fractional uncertainty in $g = (2 \times 0.0526 + 0.00114 =)0.106$;
(accept percentage, do not accept fraction)

Examiners report

[N/A]

8. *[1 mark]*

Markscheme

C

Examiners report

Consideration of units leads to C. It is not necessary to know the formula for the volume of a sphere.

9. *[1 mark]*

Markscheme

A

Examiners report

10. *[1 mark]*

Markscheme

D

Examiners report

When calculating uncertainties a distinction must be made between what is measured and what is calculated. The calculated should be made the subject of the formula before proceeding.

11. *[1 mark]*

Markscheme

B

Examiners report

[N/A]

12a. *[6 marks]*

Markscheme

(i) (±) 1 (°C);

(ii) absolute uncertainty is the same for the two points;
since T is higher at B = 90 (*stated or shown*), relative uncertainty is smaller;

or

fractional uncertainties are 0.07/
$\frac{1}{14}$ /7% for B=10 and 0.03/
$\frac{1}{33}$/3% for B=90;
fractional uncertainty is smaller for B=90;

(iii) smooth curve passing through all error bars;
Do not allow thick or hairy or doubled lines, or lines where the curvature changes abruptly.

(iv) the line is not straight/is a curve/does not have a constant gradient/is not linear;
it does not pass through the origin/(0, 0)/zero;

Examiners report

ai) Most candidates could accurately read the absolute uncertainty from an error bar. The only mistake made was by those who wrote ± 2.

aii) Most were able to calculate the fractional uncertainties, but too often the figures were not compared.

aiii) This was mainly answered well, with few straight lines.

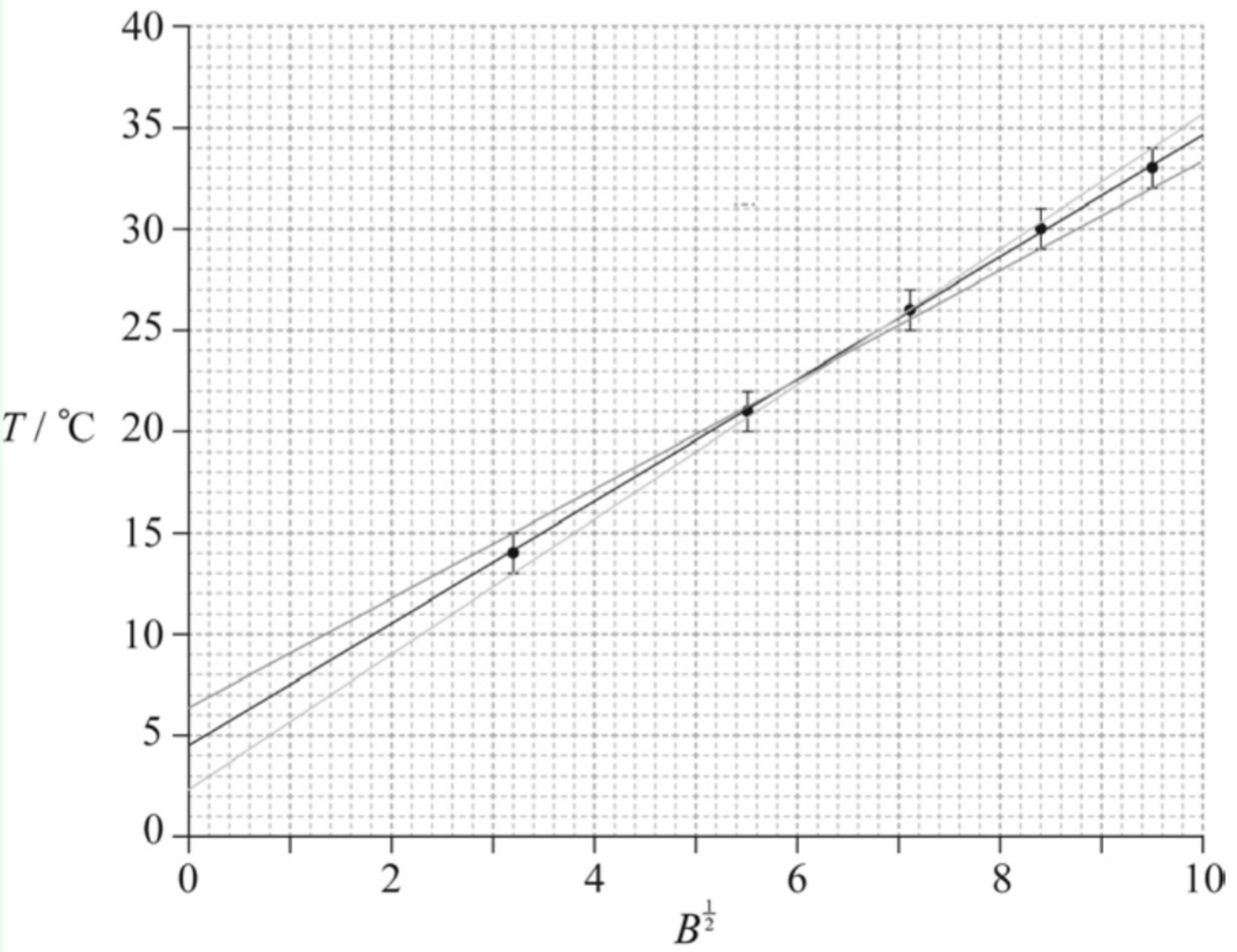
aiv) Most recognized the shape of the line required for proportionality.

12b.

[5 marks]

Markscheme

(i)



intercept read as 4.7; *(ignore significant figures, allow range of 4.5 to 4.9)*
two worst fit lines drawn through extremes of error bars;
uncertainty found from worst fit lines;
uncertainty rounded to 1 significant digit expressed in the form as ± (value)
and intercept rounded to same precision;
*Award **[4]** for a statement of 5±2 and lines drawn.*

(ii) °C ;

Examiners report

bi) Few candidates appreciated the importance of using the best and worst fit lines in finding an uncertainty from the line of best-fit. Many candidates could not state the uncertainty and value to an appropriate precision.

bii) Most candidates successfully identified the unit.

13.

[1 mark]

Markscheme

A

Examiners report

[N/A]

14.

[1 mark]

Markscheme

C

Examiners report

It was surprising to see the number of candidates who clearly did not realise that the square root involves halving the percentage uncertainty.

15.

[1 mark]

Markscheme

C

Examiners report

A number of candidates opted for B. Candidates appeared to have added the absolute uncertainty rather than adding the relative uncertainty as the approximation for finding the uncertainty in multiplication.

16.

[1 mark]

Markscheme

B

Examiners report

[N/A]

17a.

[2 marks]

Markscheme

reference to meter/instrument;
reference to constant accuracy/precision;

*Award **[2]** for “voltmeter measures to 0.1 V”.*

Examiners report

Many candidates failed to recognise that the number of decimal places is a reflection of the precision of a piece of equipment – it this case the millivoltmeter. Using different number of significant figures simply indicates that the reading is larger or smaller but it will be to the same precision. A sizeable proportion of candidates believed the number of decimal places was something that they could choose in an arbitrary manner.

17b. *[5 marks]*

Markscheme

(i) looking for constant value;
clear deviation means not/unlikely to be valid;
close to constant only means possibility of validity;

(ii) two of 105, 138, 375 correct;
third value correct;
products so far apart clearly not inversely proportional;

or

attempts to show that $\frac{d_1}{\varepsilon_2} \neq \frac{d_2}{\varepsilon_1}$ ***or*** $\frac{d_1}{d_2} \neq \frac{\varepsilon_2}{\varepsilon_1}$ for two pairs of values;
third pair of values used;
ratios so far apart clearly not inversely proportional;

Examiners report

(i) Most candidates failed to realise that the result of multiplying a series of corresponding values of ε and d only needed to show different values for the equation to be disproved but that all possible values would need to be taken prove it (clearly an impossibility).

(ii) By performing the task in (i) most candidates showed that there was too large a discrepancy between the three sets of products to suggest that the equation was viable.

17c. *[3 marks]*

Markscheme

(i) point plotted ±½ small square;

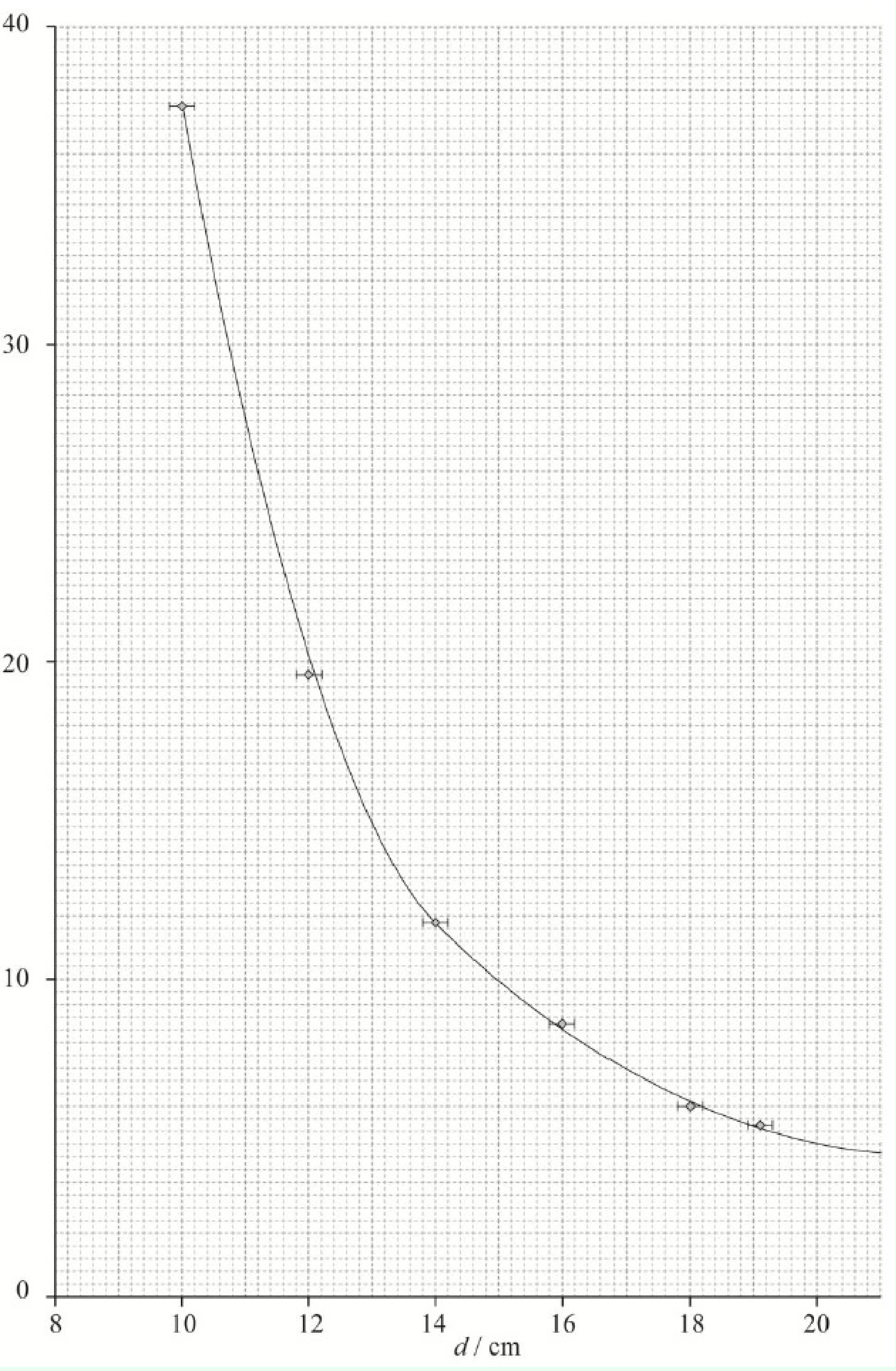
See graph for position.

1.5 small squares down +5.5 small squares across from previous plotted point.

(ii) symmetrical error bar, 1 small square in each direction ±½ small square;

(iii) single smooth curve within each error bar;

Do not condone multiple, hairy or unduly thick lines.



Examiners report

(i) Most candidates were able to correctly plot the data point despite there being a relatively difficult scale division.
(ii) The majority of candidates drew an appropriate error bar.
(iii) Many failed to take sufficient care when sketching the line of best fit. Lines of best fit are not always straight and it is important that candidates practise drawing curves in preparation for examinations. It was common to see multiple lines, some of which did not pass through the horizontal part of the error bar (the vertical edges being irrelevant and of arbitrary length).

17d. *[2 marks]*

Markscheme

% uncertainty in *d* value $\left(=\frac{0.2\text{cm}}{18\text{cm}}\right)$=1/1.1%;
% uncertainty in $d\varepsilon$ product=4/4.1%;

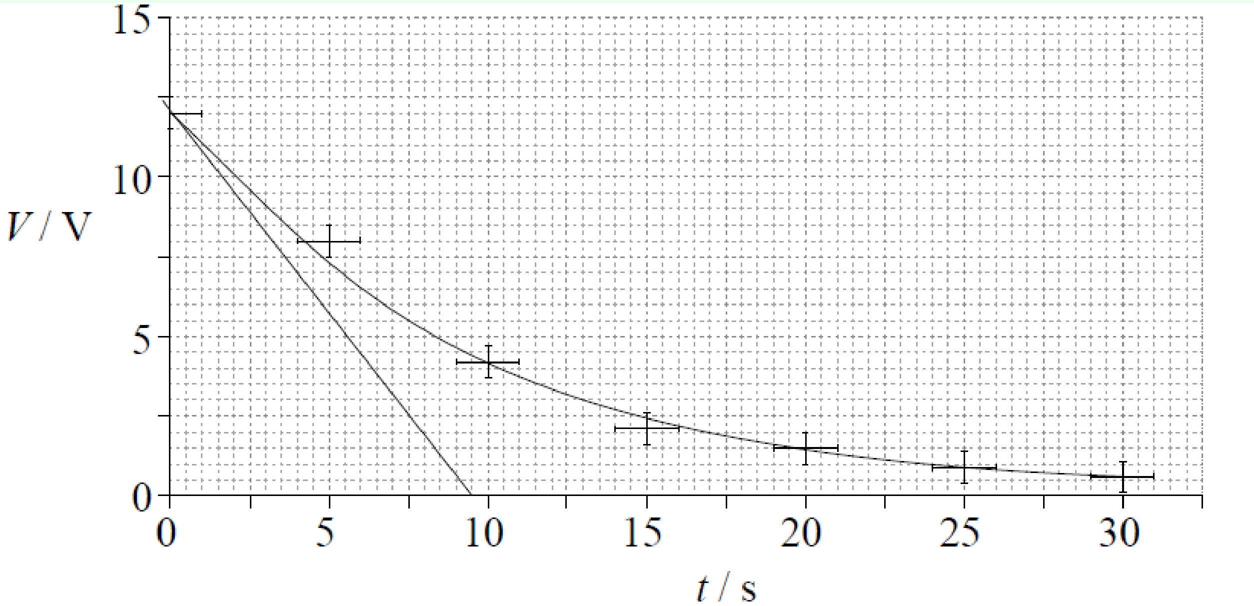
Allow ECF from wrong absolute error in d.

Examiners report

Most candidates were able to find the percentage uncertainty in the *d* value or correctly added the two percentage values; many were unable to do both.

18a. *[6 marks]*

Markscheme



(i) smooth curve; that passes through all error bars;

Award ***[1 max]*** *if an obvious straight line is drawn through first three points.*

Award ***[1 max]*** *if line touches time axis.*

Do not penalize if line starts beyond zero.

Do not allow upward curve at high t in first marking point.

Do not allow double or kinked lines.

(ii) correctly identifies three points/intervals from own graph;

correctly processes these three using exponential/half-life/constant ratio/relationship;

to conclude that decay is exponential;

within uncertainty;

Award ***[0]*** *for a bald statement.*

Award ***[1]*** *for a straight line or portion of straight line leading to conclusion that decay is* ***not*** *exponential.*

Award ***[1]*** *if uncertainties are not considered and conclusion that decay is not exponential.*

Examiners report

(i) Few candidates scored full marks. Too often examiners saw poor quality draughtsmanship and ruler-straight lines through the first three points. Most candidates were able to ensure that their lines stayed within the bounds of the error bars. Candidates are encouraged to read through the whole question before attempting to answer – had this been done then they might have gained additional clues from what followed. It should be noted that the skill being tested here was the ability of the candidates to ignore the points and draw a smooth curve through the uncertainty bars.

(ii) Good tests of exponential change were beyond many. Examiners expect to see a systematic test carried through accurately. A suitable test might include identification of halflife behaviour, constant ratio behaviour, or fitting to an exponential function. Each of these approaches could have scored full marks. Often there were vague and meaningless statements about the asymptotic behaviour of the graph.

18b.

[3 marks]

Markscheme

(i) evaluates a gradient over a minimum of 5 s to give an initial rate for example, $\left(\frac{12}{9.5}=\right)$1.3 ($Vs^{-1}$) for graph above;
(allow ECF from the graph);

Vs^{-1}*(unit paper mark)*
Clear evidence of calculation of gradient must be seen.
Accept use of (0,12) (5,8) to give 0.8 (Vs^{-1}) .

Allow answer left as fraction (eg $\frac{4}{5}$).

Accept negative gradient.

(ii) obtains evidenced answer for *t* intercept;
*Accept **one** of the following methods:*

Drawing tangent to initial part of graph (yields 9.5±3s).
Extending the first two/three points to the time axis (yields 11 – 19).
Using answer to (b)(i) to calculate intercept.

Examiners report

(i) This was adequately done by about half of the candidates although there were few confident tangents seen by examiners. Errors were to omit the unit and to try to work out a gradient over the full 30s.

(ii) Examiners expected to see an evidenced solution. Candidates who wrote down the answer without explanation gained little credit.

18c.

[1 mark]

Markscheme

$C=\left(\frac{(b)(ii)}{10\times10^{6}}=\right)1.0\times10^{-6}\left(\Omega^{-1}\mathrm{s/F}\right)$;
*Expect to see 10^6 in denominator. Award **[0]** for absence of 10^6 unless unit is in terms of MΩ.*

Examiners report

The answer here had to use the answer to (b)(ii) and most candidates were able to do this satisfactorily. A substantial number failed to take account of the prefix to the unit in the resistance and were a factor of 10^6 out in their answer.

19.

[1 mark]

Markscheme

D

Examiners report

The candidates found this question difficult with the statistics indicating that many may have been guessing. It is clear (also from paper 2) that many candidates are not comfortable with percentages. It may be a good idea for teachers to make sure their candidates can perform simple percentage calculations without recourse to a calculator.

20.

[1 mark]

Markscheme

A

Examiners report

It should be noted that 'electric field strength' is a vector quantity.

21a.

[1 mark]

Markscheme

smooth curve that goes through all error bars;
Do not allow thick or hairy or doubled lines, or lines where the curvature changes abruptly.
Do not allow lines that touch horizontal ends of error bars but miss the verticals.

Examiners report

[N/A]

21b.

[4 marks]

Markscheme

(i) (no)
reference to going through all the error bars;
the line is a curve/not straight / straight line would not pass through all the points / equal increments in l give rise to unequal increments in d;

(ii) mentions or shows clear extrapolation to l axis; { *(allow from curve or straight line)*
read-off to within a square (0.50±0.05m);
Award [1max] if no extrapolation seen on graph.
Answer must match read-off to 2+sig fig.

Examiners report

[N/A]

21c.

[4 marks]

Markscheme

two data points on line correctly read and more than 0.5 apart on *l*-axis;
$d^2 = kl$ ***or*** $d = k\sqrt{l}$;
two or more correct calculations of *k* from readings;
comment that two or more values are not equal (even with error bar consideration) therefore hypothesis is not valid;
*Award **[3 max]** if l-axis values differ by less than 0.5.*

Examiners report

[N/A]

22.

[1 mark]

Markscheme

C

Examiners report

[N/A]

23.

[1 mark]

Markscheme

C

Examiners report

[N/A]

24.

[1 mark]

Markscheme

B

Examiners report

[N/A]

25.

[1 mark]

Markscheme

B

Examiners report

[N/A]

26.

[1 mark]

Markscheme

A

Examiners report

Option C was more popular than the correct response A. Candidates failed to recognize that the spread shown indicated that there were random errors in addition to the clear systematic error.

27.

[1 mark]

Markscheme

D

Examiners report

Response B proved to be a popular distracter, particularly at SL, with candidates failing to spot that squaring the time doubles its uncertainty.

28.

[1 mark]

Markscheme

C

Examiners report

[N/A]

29. *[1 mark]*

Markscheme

A

Examiners report

[N/A]

30. *[1 mark]*

Markscheme

B

Examiners report

[N/A]

31. *[1 mark]*

Markscheme

A

Examiners report

[N/A]

32. *[1 mark]*

Markscheme

D

Examiners report

[N/A]

33. *[1 mark]*

Markscheme

A

Examiners report

B and C were commonly chosen distractors. A simple teaching strategy for such situations is to invite the candidates to consider what happens if the angle is zero. Clearly the required component also becomes zero, in which case neither B nor C can be correct.

34.

[1 mark]

Markscheme

A

Examiners report

35.

[1 mark]

Markscheme

B

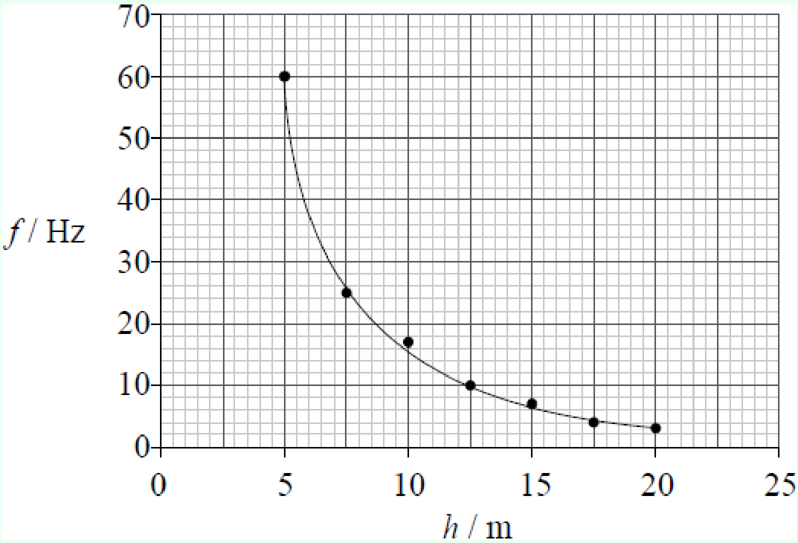
Examiners report

[N/A]

36a.

[1 mark]

Markscheme



smooth curve as above; *(judge by eye)*
Do not allow point-to-point curve.
Do not allow curve to "curl round" at low or high h.
Single "non-hairy" line only is acceptable.

Examiners report

Candidates were required to draw a smooth curve through a series of points. Few could do this adequately and it was rare to see a good construction. Lines were usually point-to-point, kinked in some way, or "hairy" (meaning that the candidate had a number of separate attempts to draw the line). This is evidently not a skill that all candidates possess.

There is still a widespread misconception that when the question asks for the candidate to "draw a best-fit line" this implies that the line is straight. This error is seen in work representing all the IB languages and is a simple point that traps candidates year after year.

36b. *[4 marks]*

Markscheme

choice of points separated by ($\Delta h \geq 7.5$) *e.g.* [6.0, 37] [15, 6.0];
recognize fh = constant for an inverse relation;
calculates fh correctly for both points;
state that two calculated numbers are not equal (therefore not inverse);
*Award **[3 max]** if data points are not on line.*
*Award **[3 max]** if data points are too close together ($\Delta h \geq 7.5$).*
*Award **[2 max]** if both of above.*

Examiners report

The question required a test of inverse proportionality. Examiners were expecting candidates to show that *fh* was *not* a constant for two well separated points. Only about 75% the cohort could manage this. Many tried to show that *f/h* was constant and gained little credit other than for choosing two well separated data points.

36c. *[5 marks]*

Markscheme

(i) a straight-line that goes through all the error bars; and drawn through the origin; *(allow ±½ square)*

(ii) read-off of suitable point(s) on line separated by at least half of drawn line;
(allow implicit use of origin)
calculation of gradient to give $1.5(\pm 0.2)\times 10^{3}$;
$s^{-1}m^{2}$ ***or*** Hzm^{2};

Examiners report

(i) This part required a straight line *going through all the error bars*. Here candidates made good attempts. A common error was to fail to draw the line through the origin.
(ii) It should have been a simple matter to determine the gradient of this graph with its intercept at the origin. Many candidates missed the 10^{-3} in the axis scaling and went on to omit the unit from their answer. A widespread failure to add units to a gradient calculation has been a feature of several recent paper 2 examinations.

36d. *[1 mark]*

Markscheme

the relation might not hold/extrapolate for larger values of *h* / outside range of experiment / values would be close to origin and with large (percentage experimental) error / girders of this height could buckle under their own weight / *OWTTE*;

Examiners report

Candidates understood the dangers of extrapolation but could not express them well.

37. *[4 marks]*

Markscheme

(i) metre^{-1};
Allow any SI prefix

(ii) one axis $\log_e \varepsilon$ /$\log_e (\varepsilon /a)$;
other axis *d;*

(iii) k=–gradient/−reciprocal of gradient;
Minus sign must be seen.
Do not allow ECF from incorrect answer to (d)(ii).

Examiners report

(i) There were good attempts at finding the unit of *k* but many candidates failed to recognise that the power in an exponential is dimensionless, giving *k* the units of d^{-1} (i.e. m^{-1} or cm^{-1}).

(ii) Although most candidates appeared to be able to perform the appropriate logarithm function to the equation many failed to take the next step and actually state what values needed to be plotted on the graph (that is, $\log_e \varepsilon$ vs. *d*).

(iii) Again, showing that the gradient was equal to $-k$, most ignored the minus sign and incorrectly stated that the gradient was *k*.

38a. *[2 marks]*

Markscheme

(i) any straight line that goes through all error bars;
(ii) line does not go through origin / (0,0) / zero;

Examiners report

[N/A]

38b. *[9 marks]*

Markscheme

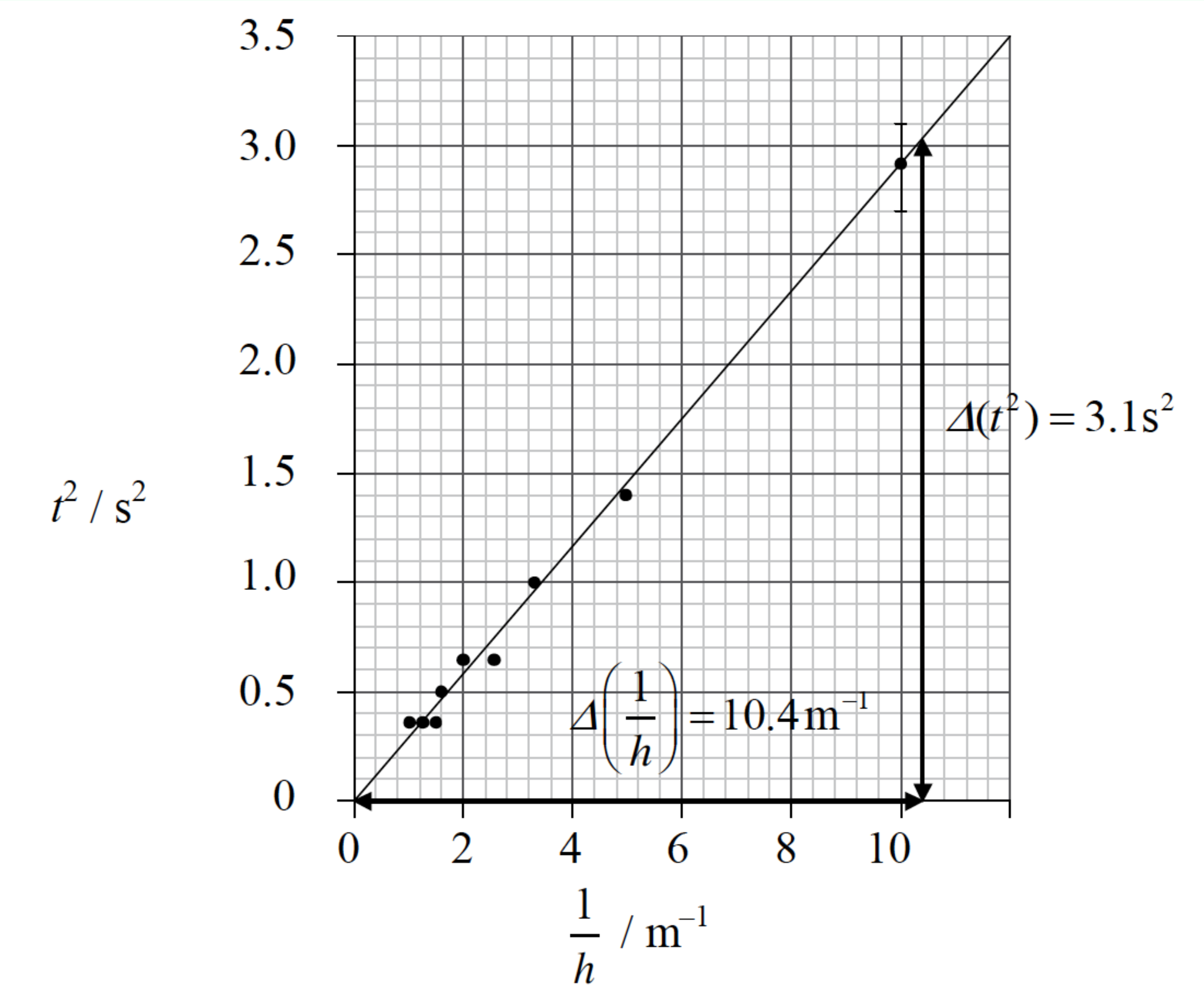
(i) ±0.35s^2; *(accept answers in range 0.3 to 0.4)*

(ii) $\frac{\Delta(t^2)}{t^2} = 2\frac{\Delta t}{t}$;
$\Delta\left(t^2\right) = 0.8^2 \times 2 \times \frac{0.1}{0.8}$;
$\Delta\left(t^2\right) = 0.16 \approx 0.2\mathrm{s}^2$;
answer given to one significant figure;

or

percentage uncertainty in $t = \frac{0.1}{0.8} \times 100 = 12.5\%$;
percentage uncertainty in t^2=25%;
absolute uncertainty in t=0.25×0.8^2=0.16≈0.2s^2;
answer given to one significant figure;

(iii)



use of gradient triangle over at least half of line;
value of gradient = 0.30; *(accept answers in range 0.28 to 0.32)*
=k^2 to give k=0.55; *(accept answers in range 0.53 to 0.57)*
or
equation of line is $t^2 = \frac{k^2}{h}$;
data values for a point on the line selected;
values substituted into equation to get k=0.55; *(accept answers in range 0.53 to 0.57)*
*Award **[2]** for answers that use a data point not on the best fit line.*

(iv) $\mathrm{m}^{\frac{1}{2}}\,\mathrm{s}$;

Examiners report

[N/A]

39a.

[4 marks]

Markscheme

(i)

fractional uncertainty in distance = $\frac{2}{150}$ and

fractional uncertainty in time = $\frac{0.5}{8.3}$; { *(allow use of percentage uncertainty)*

fractional uncertainty in speed $= \frac{2}{150} + \frac{0.5}{8.3}(= 0.074$ ***or*** $7.4\%)$;

absolute uncertainty =18×0.074;

=1.3 (cms^{-1})

or

maximum = $\frac{152}{7.8}$;

minimum = $\frac{148}{8.8}$;

shows subtraction of maximum and minimum and division by 2;

(ii) error bars drawn as ±1.3;

Examiners report

[N/A]

39b.

[3 marks]

Markscheme

(i) smooth curve within limits of all error bars;

(ii) a straight line cannot be drawn;
that goes through all the error bars / that goes through the origin;

Examiners report

[N/A]

39c.

[1 mark]

Markscheme

c versus $\sqrt{d}$ / $d^{0.5}$ ***or*** c^2 versus *d* ***or*** lg *c* versus lg *d* ***or*** ln *c* versus ln *d*;
Allow as symbols or written in words.

Examiners report

[N/A]

39d.

[2 marks]

Markscheme

(i) error that is identical for each reading / error caused by zero error in instrument / *OWTTE*;

(ii) graph will not go through origin / intercept non-zero;
graph will not be straight line/linear;

Examiners report

[N/A]

40a. *[2 marks]*

Markscheme

(i) both error bars correct (overall length 4 squares) $\pm\frac{1}{2}$ square;

(ii) smooth curve going through error bars and within half square of other points;

Examiners report

[N/A]

40b. *[3 marks]*

Markscheme

fractional error in $v = \frac{20}{250} (= 0.080)$;
fractional error in $v^{\frac{1}{3}} = \frac{0.080}{3} (= 0.027)$; *(allow ECF from first marking point)*
uncertainty in $v^{\frac{1}{3}} = (0.063 \times 0.027 =)\ 0.00169$; *(allow 0.00168−0.00170)*
Allow expression of answer as 0.630±0.002 if calculation above seen.
Award [3] for a bald correct answer.

or

recognizes uncertainty in $v^{\frac{1}{3}} = \frac{\sqrt[3]{270}-\sqrt[3]{230}}{2}$ ***or*** $\sqrt[3]{250}-\sqrt[3]{230}$ ***or*** $\sqrt[3]{270}-\sqrt[3]{250}$;
= 0.168 ;
conversion to 0.00168ms^{-1};

Examiners report

[N/A]

40c. *[5 marks]*

Markscheme

(i) large triangle > half line used;
read-offs and substitution correct; *(allow power of ten error here)*
$k^{\frac{1}{3}} = 0.012 \pm 0.001$; *(allow ECF)*
k=1.73×10^{-6} m N^{-3} s^{-1}; *(allow correct power of ten only)*
*Award **[0]** for use of a single data point.*

(ii) m N^{-3} s^{-1} ***or*** kg^{-3} m^{-2} s^{5};

Examiners report

[N/A]

41. *[1 mark]*

Markscheme

B

Examiners report

[N/A]

42. *[1 mark]*

Markscheme

D

Examiners report

[N/A]

43. *[1 mark]*

Markscheme

D

Examiners report

[N/A]

44. *[1 mark]*

Markscheme

D

Examiners report

[N/A]

45a. *[2 marks]*

Markscheme

(i) the graph is not linear/a straight line (going through the error bars) / does not go through origin ***[1]***

(ii) 7.7 ms^{-1} ; *(**N.B**. line is drawn for candidate, answer must be correct)* ***[1]***

Examiners report

(i) Most were able to identify one (of several reasons) why the proportionality did not apply.

(ii) Almost all could state the value at the required point to a sensible accuracy.

45b.

[9 marks]

Markscheme

(i) % uncertainty in $v = \left(\frac{0.3}{7.7} =\right) 3.9\%$;
doubles 3.9% *(allow ECF from (a)(ii))* to obtain % uncertainty in v^2(=7.8%);
absolute uncertainty (=±[0.078×59.3])=4.6;
(=±5m^2s^{-2})

or

calculates overall range of possible value as 7.4−8.0; (*allow ECF*)
squares values to yield range for v^2 of 54.8 to 64; (*allow ECF*)
so error range becomes 9.2 hence ±4.6; (must see this value to 2 sig fig or better to award this mark)

(ii) correct error bars added to first point (±½ square) and last-but-one point (±2.5 squares); *(judge by eye)*

(iii) a straight-line/linear graph can be drawn that goes through origin;

(iv) uses triangle to evaluate gradient; { (*triangle need not be shown if read-offs clear, read-offs used must lie on candidate's drawn line*) to arrive at gradient value of 1.5±0.2; (*unit not required)*
recognizes that gradient of graph is a^2 and evaluates a=1.2±0.2($m^{½}s^{-1}$);

or

candidate line drawn through origin and one data point read;
correct substitution into $v^2=a^2\lambda$; *(a^2 does not need to be evaluated for full credit)*

a=1.2±0.2($m^{½}s^{-1}$);

*Award [**2 max**] if line does not go through origin – allow ½ square.*
*Award [**1 max**] if one or two data points used and no line drawn.*

(v) k=9.4ms^{-2}; (*allow ECF from (b)(iv))*

Examiners report

(i) Many fully understood the simple treatment of combination of errors and arrived at a correct and well-explained solution.

(ii) The error bars were usually correctly drawn, however in a small number of cases, candidates drew the same length bar for both points (usually using the value for the upper data point).

(iii) Unlike in (b) the reasons for proportionality were usually incomplete on this occasion and few candidates scored the mark. The fact that the line goes through the origin was often ignored.

(iv) This question was done poorly; the work of many candidates was very disappointing here. Only about half the candidates attempted to draw a straight line on the graph (they were told to "Use the graph") and simply used two points on the graph without reference to a line. This gained little credit as the candidate gave no evidence at all that the chosen pair of points both lay on the line. Candidates then often compounded this by quoting a2 as the answer to the question, failing to recognize that a square root was required.

(v) Most candidates were able to take their derived a (correct or not) and evaluate k however the unit of k was usually ignored.

46a.

[1 mark]

Markscheme

line of best fit is not straight / line of best fit does not go through origin;

Examiners report

[N/A]

46b.

[8 marks]

Markscheme

(i) absolute uncertainty in diameter *D* is ±0.08cm;
giving a relative uncertainty in D^2 of $2 \times \frac{0.08}{1.26} = 0.13$ ***or*** 13%;
*Award **[2]** if uncertainty is calculated for a different ring number.*

(ii) it is possible to draw a straight line that passes through the origin (and lies within the error bars);
or
the ratio of $\frac{D^2}{n}$ is constant for all data points*;*

(iii) gradient = k;
calculation of gradient to give 0.23 (*accept answers in range 0.21 to 0.25*);
evidence for drawing or working with lines of maximum and minimum slope;
answers in the form *k* = 0.23± 0.03;
Accept an uncertainty in k in range 0.02 to 0.04. First marking point does not need to be explicit.

(iv) cm^2;

Examiners report

[N/A]

47.

[3 marks]

Markscheme

we can re-write the suggested relation as log *D* = log *c* + *p* log *n*;
now we can plot a graph of log *D* versus log *n*;
the slope of the (straight line) graph is equal to *p*;
Accept logs in any base.

Examiners report

[N/A]