Solutions

Multiple choice questions

Example 1 QLD 2017 Question 1

You can only quote in your answer the least number of sig figs in the data.

$\therefore$ **A (ANS)**

(due to the acceleration data)

Example 2 NSW 2014 Question 3

Repeating the experiment, without any changes will increase the reliability of the data.

$\therefore$ **D (ANS)**

Example 3 QLD 2013 Question 1

The value for b = 0.21, has two sig figs. Therefore the answer can only be quoted to 2 sig figs.

$\therefore$ **B (ANS)**

Example 4 QLD 2012 Question 1

0.082 has 2 sig figs., therefore the answer can only have 2 sig figs.

$\therefore$ **B (ANS)**

Example 5 NSW 2011 Question 11

$\therefore$ **D (ANS)**

Example 6 QLD 2009 Question 1

To convert from g to kg, divide by 1000. To convert from cm^3 to m^3 multiply by 100^3.

$1\,000\,000 \div 1\,000 = \times 1\,000$

$\therefore 10.5 \times 1000$

$= 1.05 \times 10^4$

$\therefore$ **B (ANS)**

Example 7 Qld 2016 Question 1

Time, t, is only measured to two significant figures. So you can only quote two in your answer.

$\therefore$ **B (ANS)**

Example 8 NSW 2010 Question 12

If $v \propto \sqrt{r}$ then $v^2 = kr$.

This means that the plot of v^2 vs r will have a gradient of k

$\therefore$ **B (ANS)**

Example 9 NSW 2008 Question 4

The relationship is not linear, as

$h = u\,t + \frac{1}{2} gt^2$

$\therefore$ **C (ANS)**

Example 10 1979 Question 23, 74%

As M increases P decreases, therefore an inverse relationship. Reading from the graph, doubling M, from 1000 to 2000, halves P from 10 to 5, therefore an inverse linear relationship.

$\therefore$ **C (ANS)**

Example 11 1977 Question 29

∴ **B (ANS)**

Example 12 1966 Question 44, 61%

To make better predictions, it is preferable to have a graph that is a straight line. As L increases V decreases, so an inverse relation exists. As L doubles, V halves, so an inverse linear relationship exists.

$V \alpha \frac{1}{L}$

∴ **B (ANS)**

Example 13 1966 Question 45, 54%

To make better predictions, it is preferable to have a graph that is a straight line. As S increases V increases. A direct relationship exists. As S doubles V increases by a factor of 4, therefore a square relationship exists.

$V \alpha S^2$

∴ **C (ANS)**

Example 14 1966 Question 46, 46%

Use the two previous answers to get

$V \alpha \frac{S^2}{L}$

∴ **B (ANS)**

Short answer questions

Example 15 QLD 2017 Question 2

2% of 52.5 = 1.05

∴ 52.5 ± 1.1

Example 16 SA 2019 Question 6a

If the drag force was directly proportional to the radius then the graph would have been an oblique straight line. It is not. It indicates that F is proportional to radius^2. When you double the radius, the force increases by a factor of 4.

Example 17 SA 2019 Question 6b i

Random

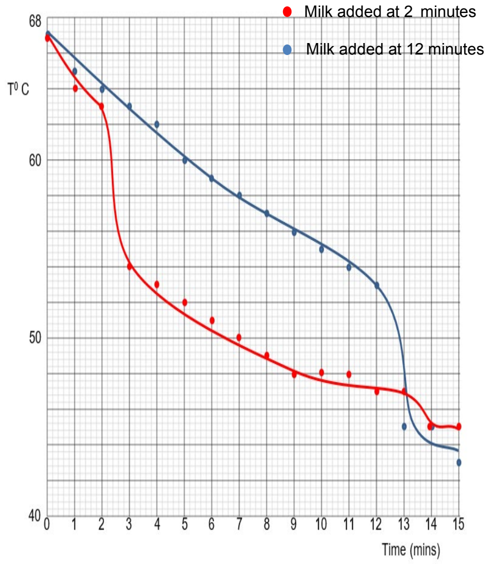
Example 18 SA 2019 Question 6b ii

An inability to keep the rocket travelling at the same speed in each trial. In other words one of the controlled variables was not controlled.

Example 19 SA 2019 Question 6c

The air resistance of the parachute would depend on its cross-sectional area, not the radius. Therefore the plot of force vs cross-sectional area should produce a linear relationship.

Example 20 QLD 2018 Question 4a



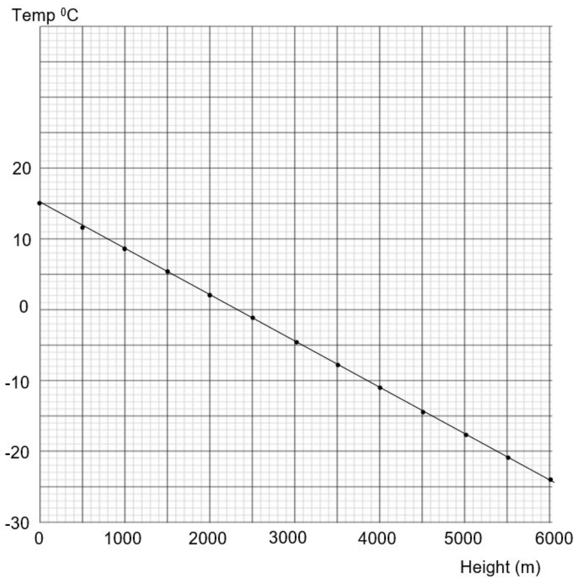
Example 21 QLD 2018 Question 4b

There appears to be very little difference. Possibly a slight advantage to milk earlier for a slightly higher final temperature.

Example 22 QLD 2018 Question 4b

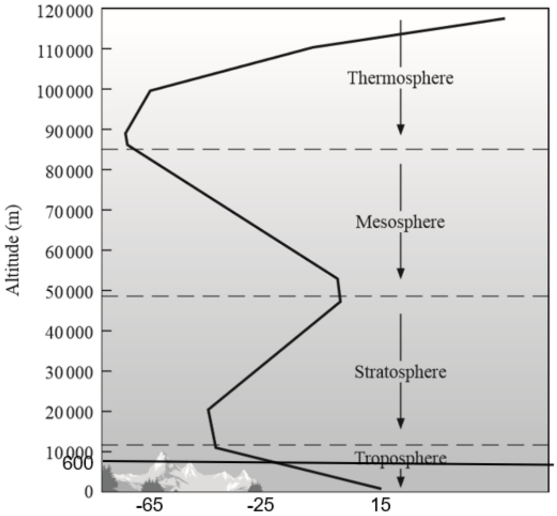
The students could wear some absorbent outer clothing.
They could weigh it before and after. The increase in weight would indicate the amount of water absorbed.
They would need to repeat the two experiments, walking and running, several times drying out the material between experiments. It would be difficult to ensure that the rain was consistent. So have two identical sets of clothing and doing the two experiments basically at the same time would assist in controlling this variable.
Students would need to change the length of the path as well.

Example 23 QLD 2017 Question 4a



Example 24 QLD 2017 Question 4b

Put a scale on the axis, using the two extreme values from the table. Extrapolate the scale.



The minimum temperature will occur in the thermosphere, and be ~ -75^0 C.

Example 25 QLD 2017 Question 5

Set up two clothes lines. One in full sun but protected from the wind, and the other in the wind but shaded from the sun.

Get 10 identical tea towels.

Completely soak all tea towels in water.

Label each tea towel.

Record all weights when saturated with water.

Hang five on the line in the sun, and 5 on the other line.

Every 15 minutes weigh each towel and replace on the same line in the same position.

Continue until the towels stop losing water.

Find average time to dry for each set of towels and analyse data.

Example 26 NSW 2016 Question 25a

Both graphs show that as distance increases, the force decreases. However, in Team A's graph, the force between the masses decreases at a decreasing rate, whereas in Team B's graph, the force decreases at a constant rate.

Example 27 NSW 2016 Question 25b

Team A's data set has a good range but too few measurements for a valid relationship to be deduced.
Team B's data set has sufficient measurements but over an insufficient range of distances for a valid relationship to be deduced.

Example 28 QLD 2016 Question 1

a. Supported

b. Unsupported

c. Supported

d. Unsupported

Example 29 SA 2014 Question 11b

A straight line through the origin should result. The line is straight but doesn't pass through the origin. This indicates that a systematic error is present.

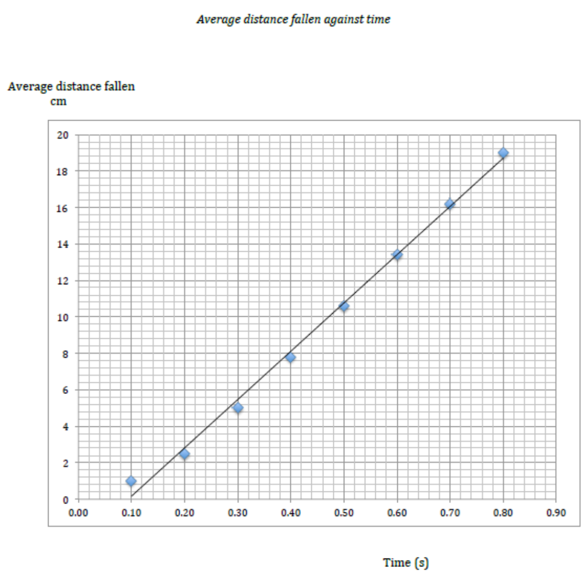
Example 30 SA 2014 Question 25a

Complete the 5th column with the following numbers1
2.5
5
7.8
10.6
13.4
16.2
19

Example 31 SA 2014 Question 25b

The units are written next to each measurement. Units should be written at the top of each column. The measurements for the average distance fallen should have a consistent number of significant figures.

Example 32 SA 2014 Question 25c



Example 33 SA 2014 Question 25d

The gradient is given by the $\frac{\text{rise}}{\text{run}}$

$\therefore$ gradient = $\frac{16}{0.7 - 0.09}$

$\therefore$ gradient = 26 cm s1

$\therefore$ **gradient = 0.26 m s^{-1} (ANS)**

Example 34 SA 2014 Question 25e

The units of the gradient indicate a distance per unit time and therefore a velocity (terminal).

Example 35 SA 2014 Question 25f (i)

The accepted/true value for the terminal speed is 0.25 m s^{-1}.
The experimental value is close to this and is therefore accurate.

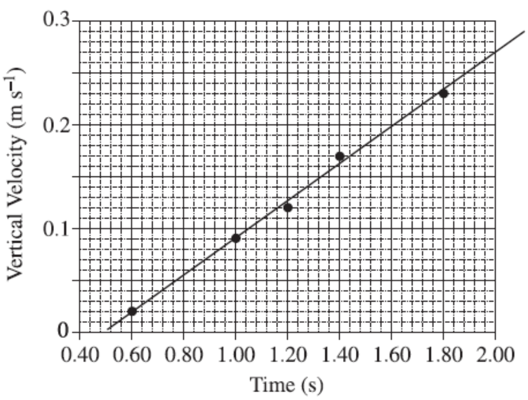
Example 36 SA 2014 Question 25f (ii)

The plotted points lie close to the line of best
fit. There is very little scatter. This means that the data is precise.
The table also indicates that repeated trials for the average distance fallen are close.

Example 37 SA 2014 Question 25g

A smaller area of cross section will result in less air resistance.
The smaller ball will take longer to reach terminal velocity.
The terminal velocity of the smaller ball will be greater.

Example 38 NSW 2013 Question 22



Use $g = \frac{\Delta v}{\Delta t}$

$\therefore g = \frac{0.235 - 0.02}{1.80 - 0.60}$

$\therefore g = \frac{0.215}{1.20}$

$\therefore$ **g = 0.18 m s^{-2} (ANS)**

Example 39 WA 2012 Question 2

The value read is 0.9 N
The uncertainty is half of one division, therefore ±0.05 N
The value read is 124 mL, from the bottom of the meniscus.
Each division is 2 ml, the uncertainty is half of one division, therefore ±1 mL.

Example 40 QLD 2012 Question 1a

i 3
ii 4
iii 2
iv 4

Example 41 QLD 2012 Question 1b

i 10.35 ± 0.6% = $10.35 + 10.35 \times \frac{0.6}{100}$

= 10.35 ± 0.062

∴ **10.35 ± 0.07 (ANS)**

(To include all possible values, this is not rounding it is uncertainty control)

ii 247 ± 5.2% =$247 + 247 \times \frac{5.2}{100}$

= 247 ± 12.844

∴ **247 ± 13 (ANS)**

(To include all possible values, this is not rounding it is uncertainty control)

Example 42 NSW 2012 Question 21a

Investigation could use different methods, including being based on a pendulum or timing a falling mass.
A computer-based timing system should be set up using a sensor to measure how long it takes for a mass to fall to the ground from several heights between 0.5 m and 3.0 m. To increase reliability several readings for each height should be recorded. The results should be plotted on a time2 vs height graph. The acceleration due to gravity is equal to 2 × the reciprocal of the slope of the line of best fit.

Example 43 NSW 2012 Question 21b

The known value (measured using more accurate equipment) should be looked up for my location, as published, for example, on the National Measurement Institute website and compared to the measured value. The closer the measured value is to the reference value, the more accurate it is.

Example 44 NSW 2012 Question 21c

The same measurement (using the same procedure) should be repeated at each height several more times. Statistically this would reduce the uncertainty in the average of all the results for each height.

Example 45 NSW 2012 Question 21d

The difference between each of the measurements and the average reading for each height the object was dropped from should be compared. If there is a large variation in the readings (relative to the average value) then the data is not very reliable.

Example 46 WA 2012 Question 18c

From the graph, 0.84 or 0.83 cm s^{-1}
Tolerance = ± 0.04 cm s^{-1}

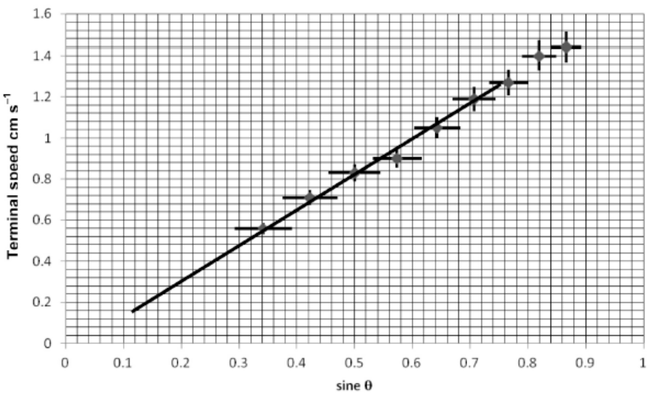
Example 47 WA 2012 Question18d

As sin θ increases the uncertainty in sin θ decreases. As terminal velocity increases the uncertainty increases.

Example 48 WA 2012 Question 18e

The value of terminal velocity when sin θ = 0.82 lies within the uncertainty range of the terminal velocity when sin θ = 0.87
Without further measurement it is difficult to determine whether the line is curving at the top.

Example 49 WA 2012 Question 18f

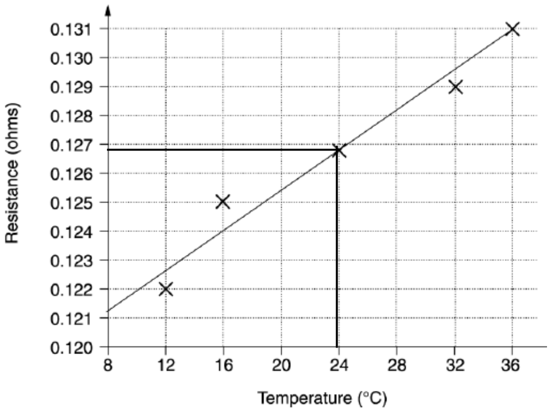


Reasonable line of best fit 1 mark
Evidence of how gradient was determined (not using 2 data points) unless they are on the line 1 mark
Gradient = 1.7 cm s-1 (must have unit)
(Range 1.5 →1.9) 1 mark

Example 50 QLD 2011 Question 1

a 45.2 ± 0.8 (ANS)
b 7.8 ± 0.8 (ANS)

Example 51 NSW 2011 Question 21a

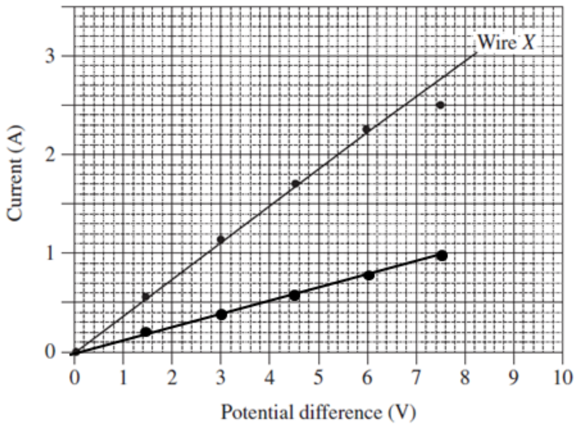


From the graph 0.1267 Ω

Example 52 NSW 2011 Question 21b

This would not be valid, as –100°C is outside the range for which the model is appropriate. Even if the model were still true at these lower temperatures, if the existing data were used the result would be imprecise, as small inconsistencies in the slope would be magnified by the process of extrapolation.

Example 53 NSW 2008 Question 27a



Example 54 NSW 2008 Question 27b,

R = V/I = 7.5 V / 0.99 A = 7.6 ohms

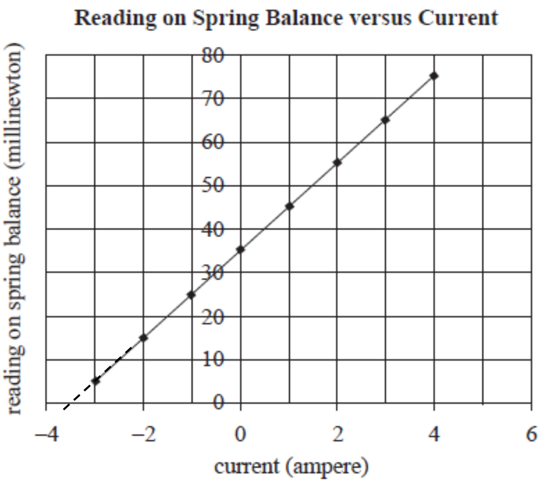
Example 55 NSW 2008 Question 27d,

The inconsistent point is (7.5, 2.5). This is below the trend line for Wire X, indicating that the resistance of the wire has increased. This is because the power dissipated by the sample at this applied voltage is sufficient to heat the sample, increasing its resistance though enhanced electron scattering by atomic vibrations.

Example 56 SA 2008 Question 12b

The dependent variable is the force acting on the wire, (as measured by the spring balance).

Example 57 SA 2008 Question 12c



From the extrapolation of the graph,
I = - 3.5 A (ANS)

Example 58 SA 2008 Question 12d

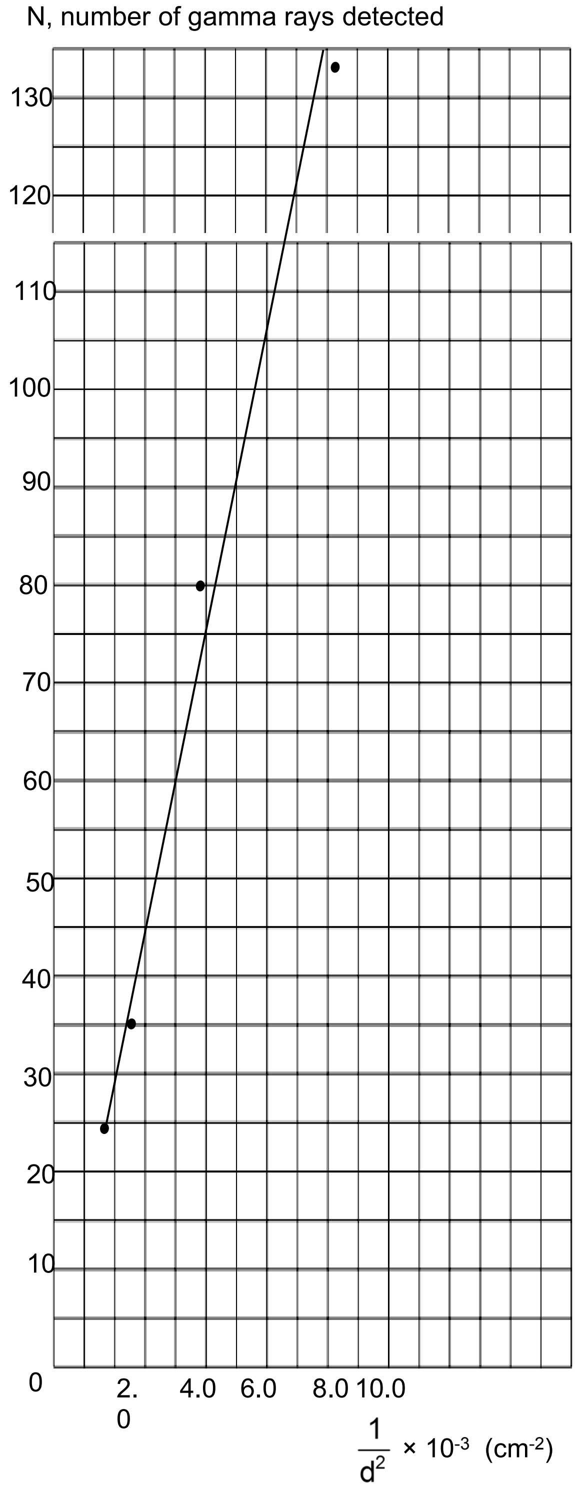
From the graph, read when I = 0,
∴ 35 milli-Newton (ANS)

Example 59 SA 2008 Question 23a

Distance d from sample to gamma counter (cm)	Number N of gamma rays detected during equal time intervals	Inverse square of distance $\frac{1}{d^2}$ (cm^{-2})
10.4	133	9.25×10^{-3}
14.4	80	4.82×10^{-3}
20.0	35	2.50×10^{-3}
25.0	24	1.60×10^{-3}

Three significant figures were required

Example 60 SA 2008 Question 23b



Example 61 SA 2008 Question 23c

The question said 'state and explain'. The relationship between N and $\frac{1}{d^2}$ is linear. This means that the intensity of the gamma rays, which is measured by the number of rays hitting a fixed area in a set time varies as $\frac{1}{d^2}$.

Example 62 SA 2008 Question 23d

The way to minimize random errors is to be careful with all aspects of the set up. To repeat measurements, with numerous trials.

Example 63 NSW 2002 Question 16a

You could measure the time for an arbitrary number of periods and then find the average time of 1 period. This would improve the accuracy of the experiment.
Also you could repeat experiment several times, measuring several values for period for each length and using the average.
The length of the string could be made longer.

Example 64 NSW 2002 Question 16b

Kim's method, of using the average, includes all the values. Kim would simply calculate *g* for each trial, by calculating $\frac{T^2}{l}$, for each L, and then finding the mean g.

Ali's method accounts for outliers better, however Ali's method of linear regression will not impose the fact that the regression line must past through the origin.
Surprisingly the Marking Guidelines say that Kim's method is "inferior" and Ali's method is "superior", they are probably correct in saying this.
Using Kim's method, we get a value of g = 9.526577949 m s^{-2}, and by using Ali's method (by using his line of best fit rather than using a calculated one) we get 9.63 m s^{-2}.

Example 65 NSW 2002 Question 16c

First we need to rearrange, $T = 2\pi\sqrt{\frac{l}{g}}$ into a form that allows us to substitute in the gradient of the line of best fit.

$$\therefore T = 2\pi\sqrt{\frac{l}{g}}$$

$$\therefore g = 4\pi^2\frac{l}{T^2}$$

$$\therefore g = 4\pi^2 \times (\text{gradient})^{-1}$$

The gradient is $\frac{9.8}{0.24} = 4.10$

$$\therefore g = 4\pi^2 \times 4.10^{-1}$$

$$\therefore g = 9.63 \text{ m s}^{-2}$$

Example 66 1968 Question 29, 49%

7.6052 – 7.6039 = 0.0013 cm
∴ **1.3×10^{-5} m (ANS)**

Example 67 1968 Question 30, 44%

Use 1 Å = 1×10^{-10} m
∴ $5014 \times 1 \times 10^{-10} = 5.014 \times 10^{-7}$
The data limits you to two significant figures,
∴ **5.0×10^{-7} m (ANS)**