

University of Cape Town
Department of Physics

Physics Measurement Questionnaire 1

Coding Schemes

For each coding scheme, the table headings are:

Code : The alphanumeric code for each category

P/S : The allocation of each category to either the point or set paradigm, if appropriate.

Category : A short description of each category.

SAG/1

Code P/S Category

N00 - No response

U00 - Not able to code response

A exactly 436 mm, because ...

A00 - (no reason given)

A01 - (not able to code reason given)

A10 P of the size of the spot, doesn't extend beyond mark.

A11 P the ball has travelled exactly 436 mm.

A12 P the spot is exactly on the 436 mm mark.

A13 P the distance is easily read/seen/observed from scale on ruler.

A20 P measurement is exact.

A41 P exact conditions for repeating will result in the exact same distance.

B approximately 436mm, because ...

B00 - (no reason given)

B01 - (not able to code reason given)

B10 P of the size of the spot.

B11 P of the size/shape/movement of ball.

B12 P the spot is not exactly on a mark.

B13 P closer markings/smaller intervals are needed, scale is too coarse.

B14 S human judgement is required to estimate reading, error of parallax.

B15 P a better measuring instrument is needed.

B16 P of the mass of the ball.

B17 U the distance the ball travels is the same as/similar to the height from which it is released.

B18 U the total distance the ball travels includes the distance along the slope, the fall from the table, and the distance covered between landing on the ground and stopping.

B21 S measurement/the reading is not exact/perfect, so use 'approximate'.

B22 S Physics, (and/or Maths), requires exact numbers, but measurements are not exact, so use 'approximate'.

B23 P the spot/dot is 'more or less' at 436 mm.

B30 U need to repeat measurements.

B31 P repeating will give a recurring value.

B32 S repeating will allow calculation of average.

B33 S repeating will confirm range of measurements.

B40 S the distance/position of spot is influenced by external factors.

B41 S the distance/position of spot is influenced by experimental procedure/measurement process.

SAG/1 cont.

C between 435 mm and 437 mm, because ...

- C00 - (no reason given)
- C01 - (not able to code reason given)
- C10 P of the size of the spot.
- C11 P of the size/shape/movement of ball.
- C12 P the spot is not exactly on a mark.
- C16 P of the mass of the ball.
- C17 U the distance the ball travels is the same as/similar to the height from which it is released.
the total distance the ball travels includes the distance along the slope, the fall
- C18 U from the table, and the distance covered between landing on the ground and stopping.
- C41 S of experimental conditions.

D between 435.5 mm and 436.5 mm, because ...

- D00 - (no reason given)
- D01 - (not able to code reason given)
- D10 P of the size of the spot.
- D11 P of the size/shape/movement of ball.
- D12 P the spot is not exactly on a mark.
- D13 P closer markings/smaller intervals are needed, scale is too coarse.
- D16 P of the mass of the ball.
- D17 U the distance the ball travels is the same as/similar to the height from which it is released.
the total distance the ball travels includes the distance along the slope, the fall
- D18 U from the table, and the distance covered between landing on the ground and stopping.
- D20 S measurement is always uncertain, can't be sure.

E I don't agree with any of you, because ...

- E00 - (no reason given)
- E01 - (not able to code reason given)
- E10 P of the size of the spot.
- E16 P of the mass of the ball.
- E17 U the distance the ball travels is the same as/similar to the height from which it is released.
the total distance the ball travels includes the distance along the slope, the fall
- E18 U from the table, and the distance covered between landing on the ground and stopping.
- E20 S measurement is always uncertain, can't be sure.
- E21 S there is no exact answer.
- E30 U repeats are necessary.
- E40 S of external factors.
- E41 S of experimental conditions.

RD/1

Code	P/S	Category
N00	-	No response
U00	-	Not able to code response
A		I think we should roll the ball <u>a few more times</u> from the same height and measure d each time because ...
A00	-	(no reason given)
A01	-	(not able to code reason given)
A10	P	practice will produce a more accurate or better measurement.
A11	P	practice will reduce the systematic error in the measurement
A12	P	you have to repeat until the readings are close together
A20	S	you need more readings to get an average/mean
A21	S	you need to get a more accurate/reliable average/mean
A22	S	you need to get an average and a spread/uncertainty
A23	S	you need to get an average and a better/narrower spread/uncertainty
A24	S	you need to get an average in order to get closer to the true value
A30	P	a few more rolls may get you the same (i.e. correct) answer
A40	P	you need to get a variety of results
A60	P	you have to do it several times (no reason provided)
A62	P	you must always take three measurements
A64	P	the answer gets more accurate; closer to the true value
A72	S	you need to determine the spread/uncertainty
A73	S	you need to determine a better/narrower spread/uncertainty
A74	P	you need to determine the uncertainty to get closer to the true value
B		Why? We've got the result already. We do not need to do any more rolling, because
B00	P	(no reason given)
B01	P	(not able to code reason given)
B30	P	repeating will give the same result
B40	P	repeating will give different results which is confusing
B50	P	repeating is a waste of time or resources
C		I think we should roll the ball down the slope <u>just one more time</u> from the same height, because ...
C00	-	(no reason given)
C01	-	(not able to code reason given)
C10	P	practice will make the second measurement more accurate
C11	P	practice will reduce the systematic error in the measurement
C20	S	you can calculate the average from two measurements
C21	S	you can get a more accurate/reliable average
C30	P	you need to see if you get the same (i.e. correct) result
C40	P	you need to get a variety of results
C50	P	many repeats are a waste of time or resources
C51	P	many repeats are desirable, but time consuming

SAB/1

Code P/S Category

- N00 - No response
U00 - Not able to code response
- A exactly 426.5 mm, because ...**
A00 - (no reason given)
A01 - (not able to code reason given)
A12 P the spot is exactly in the middle.
A41 P exact conditions for repeating will result in the exact same distance.
- B approximately 426.5 mm, because ...**
B00 - (no reason given)
B01 - (not able to code reason given)
B10 P of the size of the spot.
B11 P of the size/shape/movement of ball.
B12 P the spot is not exactly on a mark.
B13 P closer markings/smaller intervals are needed, scale is too coarse.
B14 S human judgement is required to estimate reading, error of parallax.
B15 P a better measuring instrument is needed.
B21 S measurement/the reading is not exact/perfect, so use 'approximate'.
B22 S in Science/Physics/ Maths measurements are not exact, so use 'approximate'.
B23 P the spot/reading is 'more or less' at 436 mm, so use 'approximate'.
B31 P must repeat to find accurate answer.
B32 S repeating will allow calculation of average.
B33 S repeating will confirm range of measurements.
B40 S the distance/position of spot is influenced by external factors.
B41 S the distance/position of spot is influenced by experimental procedure/measurement process.
B50 S it is the number that best represents the interval.
B51 S the measurement is approximate with respect to the true value and experimental error.
- C between 426 mm and 427 mm, because ...**
C00 - (no reason given)
C01 - (not able to code reason given)
C10 P of the size of the spot.
C11 P of the size/shape/movement of ball.
C12 P the spot is not exactly on a mark.
C13 P closer markings/smaller intervals are needed, scale is too coarse, need better calibration.
C40 S external factors cause variations when repeating.
C50 S the measurement is in the interval.

SAB/1 cont.

D	I don't agree with any of you, because ...
D00	- (no reason given)
D01	- (not able to code reason given)
D11	P of the movement/size/shape of the ball.
D30	U need to repeat measurements.
D32	S must repeat to calculate average.
D35	S repeat to get best approximation
D40	S of external factors
D41	S of experimental conditions/mistakes.
D60	U must round to the nearest 10.

RDA/1

Code	P/S	Category
N00	-	No response
U00	-	Not able to code response
A		We know enough. We don't need to repeat the measurement again, because ...
A00	P	(no reason given)
A01	P	(not able to code reason given)
A40	P	repeating will give a different result again, which is confusing
A50	P	it saves doing it again; repeats are a waste of time / resources
B		We need to release the ball <u>just one more time</u>, because
B00	P	(no reason given)
B01	P	(not able to code reason given)
B10	P	practice will make the third measurement even more accurate
B11	P	practice will reduce the systematic error in the measurement
B20	S	you need more measurements to get an average / mean
B21	S	you need to get a more accurate average / mean
B22	S	you need to get an average and a spread / uncertainty
B23	S	you need to get an average and a more accurate / narrower uncertainty
B24	S	you need to get the average in order to get closer to the true value
B30	P	the 3rd measurement may give the same (i.e. correct) answer
B31	P	you need to find a pattern in the readings.
B40	P	3 measurements are enough; too many different answers are confusing
B50	P	many repeats are a waste of time or resources
B51	P	many repeats are desirable, but time consuming
B60	P	you have to do it three times (no reason provided)
B64	P	the answer gets more accurate; closer to the true value
B72	S	you need to determine the spread / uncertainty
B73	S	you need to determine a more accurate / narrower spread / uncertainty
B74	P	you need to determine the uncertainty to get closer to the true value

RDA/1 cont.

- C** **Three releases will not be enough. We should release the ball several more times, because**
- C00 - (no reason given)
 - C01 - (not able to code reason given)
 - C10 P the more practice, the more accurate your measurement gets
 - C11 P practice will reduce the systematic error in the measurement
 - C12 P you have to repeat until the measurements are close together
 - C20 S you need more measurements to get an average / mean
 - C21 S you need to get a more accurate average / mean
 - C22 S you need to get the average/mean and the spread/uncertainty
 - C23 S you need to get the average and a more accurate spread/uncertainty
 - C24 S you need to get an average in order to get closer to the true value
 - C30 P a few more times may get you the same (i.e. correct) answer
 - C31 P you need to find a pattern in the readings.
 - C40 P you need to get a large variety of results
 - C60 P you have to do it more than three times (no reason provided)
 - C64 P the answer gets more accurate; closer to the true value
 - C72 S you need to determine the spread / uncertainty
 - C73 S you need to determine a more accurate / narrower spread / uncertainty
 - C74 P you need to determine the uncertainty to get closer to the true value
 - C80 - you need many repeated measurements for plotting a graph

UR/1

Code	P/S	Category
N00	-	No response
U00	-	Not able to code response
10	S	average of the readings is final result for d
12	P	xxx mm is final result, close to average
20	S	average of the readings, excluding the lowest reading, is final result for d
30	P	median reading is final result of d
40	S	interval is final result for d
50	P	final result is first, last, highest, lowest, reading
60	P	final result is the recurring reading

UA/1

Code P/S Category

N00		No response
U00		Not able to code response
A <i>d</i> is exactly 432 mm, because ...		
A00		(no reason given)
A01		(not able to code reason given)
A10	P	average is the true distance
A30	P	average is exactly 432 mm.
A31	P	average is calculated using a formula, and is therefore correct.
A32	P	average remains the same after more repeats.
A41	P	if individual readings differ, then the average is the exact value.
B <i>d</i> is approximately 432 mm, because ...		
B00		(no reason given)
B01		(not able to code reason given)
B10	S	average is closest to exact value/true distance.
B11	S	average is most likely value/best approximation of distance <i>d</i> .
B12	S	average is not necessarily the exact/actual/true distance.
B13	S	actual distance could be more or less than the average distance.
B16	S	average is best estimate, can never know true value.
B20	S	Error must be accounted for.
B21	S	External factors must be accounted for.
B30	S	average is approximate, not exact.
B31	S	more repeats are necessary to find accurate average/answer.
B33	S	average will/may change after more repeats.
B41	S	individual readings/measurements are not identical, so there is no exact value.
B42	S	readings are close to 432 mm.
B44	S	no reading is 432 mm.
B50	P	size/shape/movement of ball
B71	S	don't know exact interval in which <i>d</i> lies, must calculate standard uncertainty of average.
C <i>d</i> is between 431.5 mm and 432.5 mm, because ...		
C00		(no reason given)
C01		(not able to code reason given)
C11	S	average is most likely value/best approximation of <i>d</i> , but not exact.
C13	S	actual distance is close to the average.
C14	S	actual distance is in interval.
C15	S	average is actual distance rounded off/ interval accounts for rounding off.
C16	S	can never be sure of the real <i>d</i> .
C20	S	allow/account for error/uncertainty.
C30	S	average is approximate/not exact/not accurate.
C33	S	average can/will change after more repeats.
C70	S	interval allows for standard uncertainty of average, (calculate to find best estimate and standard uncertainty)

UA/1 cont.

D ***d* is between 426 mm and 436 mm, because ...**

- D00 (no reason given)
- D01 (not able to code reason given)
- D11 S average in interval, so actual distance is also in interval.
- D14 S actual distance in interval, average is best representation of interval/easy number to work with.
- D20 S account for error/uncertainty.
- D30 S average is approximate/not exact.
- D31 S more repeats are necessary to find accurate average/answer.
- D33 S average will change after more repeats.
- D34 S average is in interval.
- D40 S all readings are in that interval.
- D41 S readings spread between 426 mm and 436 mm, so can't know exact distance.
- D44 S no reading is 432 mm, so actual distance is described by the interval/range.
- D72 S interval found by calculating standard uncertainty of average, is in this interval.

E **I don't agree with any of you, because ...**

- E00 (no reason given)
- E01 (not able to code reason given)
- E13 S actual distance is close to average.
- E14 S average distance is 432 mm.
- E16 S average provides minimal value of actual distance.
- E30 S average is approximate, not exact.
- E31 S need more repeats to find accurate average/answer.
- E32 P average is the same, whatever the readings.
- E33 S average will change after more repeats.
- E42 S readings are close to 432 mm.
- E60 U average and actual *d* are unrelated.
- E70 S *d* lies in uncertainty interval about average (best estimate), must calculate.
- E71 S can't reach conclusion, need additional information about standard uncertainty.

UAA/1

Code P/S Category

- N00 - No response
U00 - Not able to code response
- A reading of 432 mm, because ...**
A00 - (no reason given)
A01 - (not able to code reason given)
A30 P average remains unchanged.
- B reading between 431 mm and 432 mm, because ...**
B00 - (no reason given)
B01 - (not able to code reason given)
B31 S average between 431 mm and 432 mm.
B40 S reading must be close to average.
- C reading between 426 mm and 436 mm, because ...**
C00 - (no reason given)
C01 - (not able to code reason given)
C10 S all readings in range 426 mm-436 mm.
C11 S readings have no set pattern.
C12 S readings vary/change/are not the same.
C20 S same experimental conditions, readings in same range.
C31 S average is between 426 mm and 436 mm.
C41 S more repeats will change average.
C50 S 434 mm occurs twice, reading likely to be close.
- D reading can have any value, because ...**
D00 - (no reason given)
D01 - (not able to code reason given)
D11 S readings have no set pattern, so can't predict.
D12 S readings vary/change/are not all the same, so can't predict.
D13 S reading can have any value, can't be predicted.
D14 S reading can have any value in specified/unspecified bigger ranager.
D20 S experimental factors affect readings.
D21 S external factors affect readings.
D40 S reading will be close to average.
D41 S reading will change average, so can't predict.
- E I don't agree with any of you, because ...**
E00 - (no reason given)
E01 - (not able to code reason given)
E12 S readings vary/change/not the same, so can't predict.
E20 S experimental conditions affect readings.
E21 S external factors affect readings.
E30 P average remains unchanged.
E40 S readings must be close to average.

SMDS/1

Code P/S Category

- N00 - No response
U00 - Not able to code response
- A A's results are better, because ...**
- A00 - (no reason given)
A01 - (not able to code reason given)
A10 S they have a smaller range/spread
A11 S they have a smaller range/spread because of outside factors
A12 S they have smaller range/spread because fewer mistakes were made
A13 S they have smaller range/spread, therefore a more accurate/reliable average
A14 S they have smaller range/spread, therefore are closer to true value
A15 S they have smaller range/spread because group A was more skilful
A20 S there is less deviance from the average
A21 S there is less deviance from the average because of outside factors
A22 S less deviance from the average because of fewer mistakes made
A25 S less deviance from the average because group A was more skilful
A40 - you usually get the results so close together
A50 P their average (435 mm) is also one of the measurements
A63 S A's results are more accurate/ consistent
- B B's results are just as good as A's, because ...**
- B00 - (no reason given)
B01 - (not able to code reason given)
B10 S they got more or less the same measurements
B20 P they have the same average
B21 P they have the same average although different outside factors caused deviation
B22 P they have the same average although mistakes caused deviation
B23 P they have the same average, and the spread is not important
B26 P they have the same average, deviation not important as expected
B29 P they have the same average and same number of readings
B30 P they have the same average, although A got 435 mm on their last measurement.
B60 - there is no exact answer to an experiment like this
B65 P the accuracy of individual readings is not under consideration, the average is important
B70 P it is a natural outcome of the same experiment, the spread is not important)
- C I think that the results of group B are better than the results of group A because ...**
- C00 - (no reason given)
C01 - (not able to code reason given)
C10 S B's results are closer together; they don't vary as much
C11 S B's average is more accurate/reliable
C12 S B's spread is smaller, so the average is more accurate
C40 - you usually get the results so close together
C50 P A's average (435 mm) is also one of the measurements

DMSS/1

Code P/S Category

- N00 - No response
 U00 - Not able to code response

A **Our results agree with yours, because ...**

- A00 - (no reason given)
 A01 - (not able to code reason)
 A10 P the readings/measurements for both sets are more or less the same
 A12 S the readings/measurements for both sets have the same spread
 A13 S the readings/measurements have an overlapping spread
 A20 P the averages are more or less the same
 A21 P the averages are more or less the same, difference due to external factors
 A22 P the averages are more or less the same, difference due to experimental errors
 A24 P the averages are more or less the same, both close to true value
 A26 P the averages are more or less the same as there will always be deviation
 A30 S the uncertainties of the averages may overlap
 A31 S the averages are more or less the same with similar ranges/spreads
 A40 P three out of five (the majority) of readings are the same
 A41 P group A's first reading is the same as group B's last reading
 A50 P if you round off the averages, then they are identical

B **No, your results do not agree with ours, because ...**

- B00 - (no reason given)
 B01 - (not able to code response)
 B12 S the spreads of both sets are different
 B20 P The averages are different
 B21 P The averages are different due to different conditions/external factors
 B22 P The averages are different due to experimental errors
 P The averages are different, absolute accuracy/identical results required to agree
 B25
 B26 P The averages are too different even though deviation is taken into consideration
 B30 S the averages are too far apart for the uncertainties to overlap
 B31 P average is different and all individual readings are not the same
 B32 S The spread differs between the two
 B40 P both groups got some different measurements
 B50 P if you round off the averages, then they are very different
 B60 P an average is only true if the average value also appears as one of the measurements
 B61 P an average is only true if the average value does not appear as one of the measurements
 B80 P group B is more accurate than group A

SD/1

Code P/S Category

N00 - No response

U00 - Not able to code response

A exactly 423.7 mm, because ...

A00 - (no reason given)

A01 - (not able to code reason given)

A11 P the ball has travelled exactly 423.7 mm.

A12 P the reading is 423.7 mm.

A15 P electronic meter gives exact/accurate answers.

A41 P exact conditions for repeating will result in the exact same distance.

B approximately 423.7 mm, because ...

B00 - (no reason given)

B01 - (not able to code reason given)

B10 P of the size of the spot.

B11 P of the size/shape/movement of ball.

B12 S the reading is approximate.

B13 P meter not sensitive enough, need better calibration.

B14 S human judgement is required to estimate reading, error of parallax.

B15 P a better measuring instrument is needed.

B21 S measurement/the reading is not exact/perfect, so use 'approximate'.

B22 S in Science/Physics/Maths measurements are not exact, so use 'approximate'.

B24 S measurement close to true value, so use approximate.

B30 U need to repeat measurements.

B31 P repeating to confirm, get recurring value.

B32 S repeating to account for scatter by calculation of average.

B34 S there are variations when repeating.

B40 S variations caused by external factors.

C between 423 mm and 424 mm, because ...

C00 - (no reason given)

C01 - (not able to code reason given)

C13 P need better calibration, more sensitive.

C15 P need better measuring device, meter inaccurate.

C20 S reading is not exact, use interval.

C33 S repeats will confirm range, readings will fall in interval.

C40 S of external factors

C41 S of experimental method/measuring process.

D between 423.65 mm and 423.75 mm, because ...

D00 - (no reason given)

D01 - (not able to code reason given)

D10 P of the size of the spot.

D11 P of the size/shape/movement of ball.

D13 P closer markings/smaller intervals are needed, scale is too coarse, need better calibration

D15 P need better measuring instrument.

D20 S measurement is always uncertain, can't be sure.

D41 S of experimental method/measuring process.

SD/1 cont.

E	I don't agree with any of you, because ...
E00	- (no reason given)
E01	- (not able to code reason given)
E15	S of mistakes of the measuring device.
E20	S measurement is always uncertain, can't be sure.
E30	U repeats are necessary.
E31	P repeat to confirm, find recurring value.
E32	S repeat to account for scatter and calculate average.
E34	S repeat to account for external factors and approximate.
E40	S of external factors.

UU/1

Code	P/S	Category
------	-----	----------

- | | | |
|-----|---|---------------------------|
| N00 | - | No response |
| U00 | - | Not able to code response |

A		If we practice enough and work very carefully, all our readings will be the same and we will know the true value of d, because ...
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- | | | |
|-----|---|---|
| A00 | - | (no reason given) |
| A01 | - | (not able to code reason) |
| A10 | P | “practice makes perfect.” |
| A11 | P | perfecting experimental method will result in a true/accurate/best value. |
| A12 | P | if external factors are taken into account, results will be exact/accurate. |
| A13 | P | exact conditions for repeating experiment will give exact results. |
| A20 | P | if all the readings are the same, then that recurring value is the true value of d. |

B		No, even if all the readings are the same, we will still not know the true value of d, because ...
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- | | | |
|-----|---|---|
| B00 | - | (no reason given) |
| B01 | - | (not able to code response) |
| B11 | S | you cannot avoid experimental mistakes. |
| B12 | S | you cannot control external factors, and therefore, cannot know true value. |
| B13 | S | exact conditions for repeating experiment will give exact results, BUT conditions change. |
| B21 | S | results will always vary. |
| B30 | S | no true value, can only approximate. |
| B31 | S | no true value, use average. |