Section 2.1 Question 1

The combination of quality assurance and quality control in a forensic laboratory is designed to
a) ensure all laboratories are performing the exact same methods
b) keep analysts busy
c) ensure that customers know every step that is taken inside the laboratory
*d) ensure the goodness of the data produced
e) none of the above

Section 2.1 Question 2

Quality assurance is defined here as
a) the specific procedures used to ensure goodness of data
*b) the overall system that ensures the goodness of data
c) the procedures required of the submitting agency before samples are submitted
d) the same thing as quality control; the terms are interchangeable
e) none of the above

Section 2.1 Question 3

Quality control is defined here as
*a) the specific procedures used to ensure goodness of data
b) the overall system that ensures the goodness of data
c) the procedures required of the submitting agency before samples are submitted
d) the same thing as quality assurance; the terms are interchangeable
e) none of the above

Section 2.1 Question 4

What is meant by the term “cradle to grave” relative to QA/QC?

a) The system applies as long as the submitting agency exists
b) The system applies as long as the defendant is under indictment
*c) The system applies as long as the evidence and data is under the laboratory’s control
d) The system applies as long as the analyst is working on the evidence
e) None of the above

Section 2.1 Question 5
The documentation that shows where is evidence is and who controls it all all times is the
a) pedigree
*b) chain of custody
c) QA/QC writ
d) standard operating procedure
e) none of the above

Section 2.1 Question 6

The international body the coordinates standards of metrology and definitions is
a) NIST
*b) BIPM
c) AOAC
d) OSAC
e) none of the above

Section 2.1 Question 7

Suppose you needed a generally accepted definition of a term such as accuracy. Which resource would be the best choice?
a) Google search
*b) the VIM
c) Wikipedia
d) My roommate who knows a lot
e) none of the above

Section 2.1 Question 8

What is the key difference between accreditation and certification in the forensic context?
a) None; these terms are used interchangeably
*b) Laboratories can be accredited; analysts can be certified
c) Analysts are first certified and can then be accredited
d) Laboratories are first certified and can then be accredited
e) none of the above

Section 2.1 Question 9

Which organization provides the detailed analytical procedures that all forensic laboratories must use?
a) ISO
b) BIPM
c) VIM
d) OSAC
*e) No organization provides these
f) none of the above

Section 2.1 Question 10

The document that describes an analytical procedure used in a laboratory in detail is called the
a) ISO accreditation requirements
b) OSAC consensus standard
c) Traceable method protocol
*d) Standard operating procedure (SOP)
e) none of the above

Section 2.1 Question 11

Traceability means that a measured value
*a) can be tied to an internationally accepted standard reference
b) will be the same no matter where, when, or how it is obtained
c) the results are always correct (within the ± range)
d) Errors are minimized to the lowest possible amount
e) none of the above

Section 2.1 Question 12

You are tasked with developing a critical assay to detect a poison in biological fluids. Quantitation has to be as exact as possible. Your best choice when purchasing a chemical standard is a
a) Analytical standard
b) Reference material (RM)
*c) Certified reference material (CRM)
d) Accredited reference material (ARM)
e) none of the above

Section 2.1 Question 13

The primary purpose of a calibration curve is to
a) Assure measurements are falling within the range of expected values
b) Test for traceability
c) Assure that methods are meeting international standards
*d) reliably convert an instrument output into the units of interest
e) none of the above

Section 2.1 Question 14

A balance calibration curve (weight vs. force) as shown in the text has a slope of 7.385 and an intercept of 4.029. What weight in grams will the device show when the downward force is 267.1 (arbitrary units)? The balance reads to two decimal places.
*a) 35.62
b) 35.622
c) 64.5
d) 64.46
e) none of the above

Section 2.1 Question 15

Control charts are used to
*a) monitor performance of an instrument or method over time
b) control fluctuations in environmental conditions
c) establish the reliability of a certified method
d) ensure traceability of a method or material
e) none of the above

Section 2.1 Question 16

The warning limit of a control chart are typically +/-
a) 1 standard deviation unit
*b) 2 standard deviation units
c) 3 standard deviation units
d) 4 standard deviation units
e) none of the above

Section 2.1 Question 17

The control limits of a control chart are typically +/-
a) 1 standard deviation unit
b) 2 standard deviation units
*c) 3 standard deviation units
d) 4 standard deviation units
e) none of the above

Section 2.2 Question 1

The linear dynamic range of a calibration curve is the range in which
a) a linear range is expected to change dynamically
b) concentration depends on response
c) the correlation coefficient is greater than 1
*d) a linear equation applies
e) none of the above

Section 2.2 Question 2

Suppose a data point falls below the LOQ, but above the LOD. This means that
a) the linear equation can still be used but with extra uncertainty
b) the concentration is probably less than zero
c) the calibration curve cannot be used
d) the point is a false positive
*e) none of the above

Section 2.2 Question 3

When first establishing a calibration curve, which data points can be removed?
a) None
b) A maximum of 3 out of every ten
*c) Points on either extreme (lowest or highest concentration)
d) Any replicate in excess of three
e) none of the above

Section 2.2 Question 4

The correlation coefficient (R2) is a measure of
a) the expected linear range of the calibration curve
b) the ratio of the slope to the intercept
c) the reliability of the calibration curve
*d) the degree of linearity of the calibration curve
e) none of the above

Section 2.2 Question 5

Which type of calibration provides the best matrix match?
a) External standard

b) Internal standard
*c) Standard addition
d) Matrix dilution addition
e) none of the above

Section 2.2 Question 6

An analyst performs and external standard calibration for fentanyl and obtains the following data points (concentration in ppb, area counts):

20.0, 9599
50.0, 21456
100.0, 45326
250.0, 102391
500.0, 210561

What is the slope and the intercept of the resulting linear equation (to one decimal place)?
a) 213.3, 605.4
*b) 416.6, 1213.7
c) 605.4, 213.1
d) 1213.7, 416.6
e) none of the above

Section 2.2 Question 7

An analyst performs and external standard calibration for fentanyl and obtains the following data points (concentration in ppb, area counts):

20.0, 9599
50.0, 21456
100.0, 45326
250.0, 102391
500.0, 210561

What is the R2 value of the resulting linear equation (3 decimal places)?
a) 0.926
*b) 0.999
c) -0.926
d) -0.999

e) none of the above

Section 2.2 Question 8

An analyst performs and external standard calibration for fentanyl and obtains the following data points (concentration in ppb, area counts):

20.0, 9599
50.0, 21456
100.0, 45326
250.0, 102391
500.0, 210561

Using the resulting calibration curve, calculate the concentration of fentanyl (ppb) in a sample that generates area counts of 48722 (4 digits).
*a) 114.0
b) 39.80
c) 386.0
d) 59.80
e) none of the above

Section 2.2 Question 9

You are tasked with creating an internal standard calibration curve. For the first calibration level, the concentration of the analyte is 25.0 ppb. The concentration of the internal standard is 50.0 ppb. What is the concentration ratio value that will be used to plot the first data point?
a) 0.500
b) 1.50
c) 0.750
*d) 2.00
e) none of the above

Section 2.2 Question 10

Which type of calibration curve uses ratios of concentrations and responses?
a) External standard
*b) Internal standard
c) Standard addition
d) force to weight
e) none of the above

Section 2.2 Question 11

You are tasked with creating an internal standard calibration curve. For the third calibration level, the area response of the analyte is 19087. The area of the internal standard is 1200.0 What is the area ratio value that will be used to plot the first data point?
a) 42.000
b) 1.8220
*c) 15.906
d) 0.063
e) none of the above

Section 2.2 Question 12

An internal standard curve is described by the linear equation $y = 20.42x – 0.7223$. A sample is analyzed and the ratio of the area counts of the target analyte to the internal standard is 1.052. The internal standard concentration is 75.0 ppb. What is the concentration of the target analyte in the sample (ppb, 2 decimal places)?
a) <LOD
b) 1.21
*c) 6.52
d) 17.43
e) none of the above

Section 2.2 Question 13

To use an internal standard method, which samples must contain an added internal standard?
a) the calibration standards
b) the blanks and calibration standards
c) the matrix blank and calibration check
*d) all the samples
e) none of the above

Section 2.2 Question 14

Which of the following is false regarding an internal standard compound
a) It should be chemically similar to the target analyte
b) It has to be added to all of the analytical samples
*c) It must be water soluble
d) It cannot be present in the samples

e) none of the above

Section 2.2 Question 15

A standard addition curve is described by the linear equation y = 319.9x+3709 with concentration in ppb. What is the concentration of the analyte in ppb (to one decimal place)?
a) 37.1
b) 319.9
c) <LOD
*d) 11.6
e) none of the above

Section 2.2 Question 16

What is the difference between bias and trueness as used in forensic chemistry?
*a) None; the terms are synonymous
b) Bias is typical larger than trueness
c) Trueness depends on the spread of the data; bias does not
d) Bias is a component of ruggedness; trueness is a component of robustness
e) none of the above

Section 2.2 Question 17

Why does accuracy have two components?
a) Because of ruggedness and robustness
b) Because of normal random error
*c) Because the difference between two values depends on the difference between the mean value and the normal expected variation of both values
d) Just to make my life more difficult
e) none of the above

Section 2.2 Question 18

An analyst decides to calculate the %error as a measure of bias. A certified reference material (CRM) contains a drug metabolite at a concentration of 12.8 micromolar ± 0.03 micromolar. The analyst tests this sample and obtains a result of 12.1 micromolar ± 0.1 micromolar. What is the %error (to one decimal place)?
a) 5.5
*b) -5.5
c) -5.8

d) 5.8
e) none of the above

Section 2.2 Question 19

What is a better term for a true value?
a) none; it is what it is
*b) accepted true value
c) consensus value
d) accredited value
e) none of the above

Section 2.2 Question 20

Which expression of precision will have the smallest value?
*a) repeatability
b) reproducibility
c) ruggedness
d) robustness
e) none of the above

Section 2.2 Question 21

Which expression of precision includes measurements that incorporate small changes in conditions?
a) repeatability
*b) reproducibility
c) ruggedness
d) robustness
e) none of the above

Section 2.2 Question 22

Suppose a lab is validating a method using GC-MS and decide to incorporate different vendor sources of methanol in determining the normal expected variation of results. This would be expressed as part of
a) repeatability
b) reproducibility
*c) ruggedness
d) robustness

e) none of the above

Section 2.2 Question 23

Sensitivity is another term for
a) the warning limits of a control chart
*b) the slope of a calibration curve
c) robustness
d) bias
e) none of the above

Section 2.2 Question 24

A common method for establishing an LOD is
a) guessing
*b) calculating 10x the signal to noise ratio
c) establishing the LOQ and dividing by 10
d) establishing the LLOQ and dividing by 10
e) none of the above

Section 2.2 Question 25

In the context of qualitative methods, what is a decision threshold?
*a) The concentration at which a result is definitively positive
b) The false positive rate
c) The false negative rate
d) The true negative rate
e) none of the above

Section 2.2 Question 26

A police officer uses a color test on a suspicious white powder. She does not know that the material is powdered sugar. No color change is observed. This is an example of a
a) false positive
b) true positive
c) false negative
*d) true negative

e) none of the above

Section 2.3 Question 1

A laboratory receives a seizure of 1000 tablets. They decide to test 10% of these. These tests show that all tablets contain methamphetamine. This is an example of
*a) arbitrary sampling
b) statistical sampling
c) Bayesian sampling
d) quantitative sampling
e) none of the above

Section 2.3 Question 2

A laboratory receives a seizure of 1000 tablets. They decide to test 10% of these. These tests show that all tablets contain methamphetamine. What can the laboratory report?
*a) 100 tablets contained methamphetamine
b) 100 tablets contained methamphetamine and the remainder probably do
c) 100 tablets contained methamphetamine and there is a 95% chance that the rest do
d) 100 tablets contained methamphetamine and there is a 95% chance that the remaining 900 contain methamphetamine
e) none of the above

Section 2.3 Question 3

Sampling based on the hypergeometric distribution function is an example of
a) arbitrary sampling
*b) statistical sampling
c) Bayesian sampling
d) quantitative sampling
e) none of the above

Section 2.3 Question 4

Which of the following is false regarding the hypergeometric sampling method?
a) It is designed for quantitative sampling
b) It provides a statistical basis for sampling
c) It allows statements regarding untested samples
d) Requires that the samples belong or appear to belong to the sample population
*e) none of the above

Section 2.3 Question 5

A laboratory receives a seizure of 592 kilogram "bricks" of white powder. All appear to be similar based on physical characteristics. The legal threshold that divides charges between possession (less severe potential punishment) from distribution (more severe potential punishment) is 10 kilograms. Assuming all weigh close to a kilogram, what is the minimum number of bricks that must be shown to contain a controlled substance?
a) 1
b) 9
c) 10
*d) 11
e) none of the above

Section 2.3 Question 6

A laboratory receives a seizure of 592 kilogram "bricks" of white powder. All appear to be similar based on physical characteristics. The laboratory has tested many such seizures in the past months and all have been shown to be cocaine. Use the ENFSI spreadsheet to determine how many samples must be initially tested to show that 90% of the seizure contains cocaine with 95% confidence.
a) 53
b) 12
*c) 28
d) 60
e) none of the above

Section 2.3 Question 7

A laboratory receives a seizure of 592 kilogram "bricks" of white powder. All appear to be similar based on physical characteristics. The laboratory has tested many such seizures in the past months and all have been shown to be cocaine. Use the ENFSI spreadsheet to determine how many samples must be initially tested to show that 99% of the seizure contains cocaine with 99% confidence.

a) 56
*b) 316
c) 315
d) all of them
e) none of the above

Section 2.3 Question 8

A laboratory uses the hypergeometric method for sampling a large seizure. The SOP requires a confidence level of 95%. What can the analyst say in a report or in court regarding this value?
a) The odds are 1:20 that all the samples contained the same drug
b) 1:20 odds that there are at least two negative samples in the seizure
c) 95% is like a grade; the bigger the better
*d) If the same sampling plan is used again, 95 times out of 100, you will get the same result
e) none of the above

Section 2.4 Question 1

Measurement uncertainty expresses
*a) the normal expected variation of a measured value
b) the typical expected error of a measured value
c) the quantitative estimate of doubt associated with a measurement
d) the probability of over or underestimation of a value
e) none of the above

Section 2.4 Question 2

All of the following are true regarding measurement uncertainty except
a) it is an estimate
b) it does not imply doubt
*c) it expresses the “P” or pedigree in NUSAP
d) there usually many ways to estimate it
e) none of the above

Section 2.4 Question 3

Which approach to estimation of uncertainty utilizes a measurement assurance sample?
*a) top-down
b) tangent approach
c) model approximation
d) bottom up
e) none of the above

Section 2.4 Question 4

Which approach to estimation of uncertainty is based on many individual contributors identified in a cause and effect diagram?
a) top-down
b) tangent approach
c) model approximation
*d) bottom up
e) none of the above

Section 2.4 Question 5

The tolerance of a volumetric flask is documented as ± 0.05 mL. What type of distribution is this considered for measurement uncertainty estimation?
*a) Type A
b) Type B
c) Type C
d) Combined or mixed type
e) none of the above

Section 2.4 Question 6

An analyst performs a series of weighings of a traceable weight and obtains a standard deviation of these weighings. What type of distribution is this considered for measurement uncertainty estimation?
a) Type A
*b) Type B
c) Type C
d) Combined or mixed type
e) none of the above

Section 2.4 Question 7

Which of the following is NOT an example of a type B contributor in measurement uncertainty?
a) readability of a balance
*b) reproducibility of a balance
c) tolerance of a calibrated pipet
d) rounding of the last digit in a digital display
e) none of the above

Section 2.4 Question 8

A contributor to an uncertainty estimate is designated as a triangular distribution. This value must be divided by the square root of 6 before being used. Why?
a) To ensure that no negative values are included
b) It is twice the size of the square root of 3 used for rectangular measurements
c) To ensure statistical reliability
*d) This converts the +/- value to the equivalent of one standard deviation which all contributors must be expressed as

e) none of the above

Section 2.4 Question 9

Why is the combined uncertainty multiplied by the coverage factor (k)?
a) to ensure no negative values occur
b) to restore the range to a type A distribution
*c) to expand the range out to more than ± 1 standard deviation unit
d) to restore the range to a rectangular distribution
e) none of the above

Section 2.4 Question 10

A laboratory validates a method for weighing solid dose drug powders on a single balance used by 4 analysts. They establish the figures of merit shown in the portion of the uncertainty budget shown below.

Factor	Value	Units	Distribution Type	Conversion factor
Linearity	0.028	g	Rectangular	1.7321
Repeatability	0.058	g	Normal	1.0000
Readability	0.010	g	Rectangular	1.7320

What is the value of the contributor for the repeatability when converted to the equivalent of one standard deviation:
a) 0.0058
b) 0.0162
c) 0.667
d) 2.00
*e) none of the above

Section 2.4 Question 11

A laboratory validates a method for weighing solid dose drug powders on a single balance used by 4 analysts. They establish the figures of merit shown in the portion of the uncertainty budget shown below.

Factor	Value	Units	Distribution Type	Conversion factor
Linearity	0.028	g	Rectangular	1.7321
Repeatability	0.058	g	Normal	1.0000
Readability	0.010	g	Rectangular	1.7320

What is the combined standard uncertainty for this balance in grams rounded to the same number of digits as the balance displays?

a) 0.04
b) 0.71
c) 0.06
d) 0.12
*e) none of the above

Section 2.4 Question 12

A laboratory validates a method for weighing solid dose drug powders on a single balance used by 4 analysts. They establish the figures of merit shown in the portion of the uncertainty budget shown below.

Factor	Value	Units	Distribution Type	Conversion factor
Linearity	0.028	g	Rectangular	1.7321
Repeatability	0.058	g	Normal	1.0000
Readability	0.010	g	Rectangular	1.7320

What is the % contribution of the repeatability to the overall uncertainty rounded to zero decimals?

a) 7
b) 92
c) 97
d) 1
e) none of the above

Section 2.4 Question 13

A laboratory validates a method for weighing solid dose drug powders on a single balance used by 4 analysts. They establish the figures of merit shown in the portion of the uncertainty budget shown below.

Factor	Value	Units	Distribution Type	Conversion factor
Linearity	0.028	g	Rectangular	1.7321
Repeatability	0.058	g	Normal	1.0000
Readability	0.010	g	Rectangular	1.7320

A case sample is weighed on this balance with a result of 28.35 grams. What is the estimated uncertainty of this weight with a coverage factor of 2 (~95%) in grams?

*a) 0.12
b) 1.31
c) 0.058
d) 0.060
e) none of the above

Section 2.4 Question 14

The toxicology section of a medical examiner's office creates an uncertainty budget for a drug metabolite quantitation as shown below.

Factor	Value	Units	Converted value	Units	Distribution Type	Conversion factor	u	u2	% relative contribution
Calibration standard	1.00	%	10.00	ng/uL	Rectangular	1.7321	0.57735	0.33	1%
MAS	5.810	ng/ul	5.810	ng/uL	Normal	1.0000	5.81000	33.8	99%

Why is the contribution for the measurement assurance sample so large?

a) Because the budget is for toxicology, not weighing drugs
*b) Measurement assurance samples are designed to capture many contributing factors into one value
c) It is a type A distribution which is always larger
d) It is a type B distribution which is always larger
e) none of the above