

※請在答案卡內作答

一、單選題(每題 2.5 分，共 40 題，合計 100 分)

1. For a data value set that is Gaussian distributed, what is the likelihood (%) that a data point will be within  $\pm 1$  SD from the mean?  
(A) 68%      (B) 99%      (C) 95%      (D) 100%      (E) 50%
2. The correlation coefficient  
(A) is always expressed as "b"  
(B) determines the regression type used to derive the slope and y-intercept  
(C) indicates the strength of relationship in a linear regression  
(D) express method imprecision  
(E) none of the above
3. If two methods agree perfectly in a method comparison study, the slope equals \_\_\_\_\_ and the y-intercept equals \_\_\_\_\_.  
(A) 0.0, 1.0      (B) 1.0, 1.0      (C) 0.0, 0.0      (D) 0.5, 0.5      (E) 1.0, 0.0
4. Systematic error can best be described as consisting of  
(A) Constant and proportional error  
(B) Constant error  
(C) Proportional error  
(D) Random error  
(E) Syntax error
5. Stray light in a spectrophotometer places limits on  
(A) Sensitivity  
(B) Upper range of linearity  
(C) Photometric accuracy below 0.1 absorbance units  
(D) Ability to measure in the UV range  
(E) Use of a grating monochromator
6. Which of the following techniques has the highest potential sensitivity?  
(A) Chemiluminescence  
(B) Fluorescence  
(C) Turbidimetry  
(D) Nephelometry  
(E) Phosphorescence

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7. Which electrochemical assay measures current at fixed potential?
- (A) Anodic stripping voltammetry
  - (B) Coulometry
  - (C) Amperometry
  - (D) Analysis with ion-selective electrodes (ISEs)
  - (E) Electrophoresis
8. Reverse-phase liquid chromatography refers to
- (A) A polar mobile phase and nonpolar stationary phase
  - (B) A nonpolar mobile phase and polar stationary phase
  - (C) Distribution between two liquid phases
  - (D) Size used to separate solutes instead of charge
  - (E) Charge used to separate solutes instead of size
9. Which of the following is *FALSE* concerning the principles of point-of-care testing devices?
- (A) Devices do not require quality control testing.
  - (B) They use principles that are identical to laboratory-based instrumentation.
  - (C) Biosensors have enabled miniaturization particularly amenable for point-of-care testing.
  - (D) Onboard microcomputers control instrument functions and data reduction.
  - (E) Whole blood analysis is the preferred specimen.
10. Which of the following best describes the process of fluorescence?
- (A) Atoms emit a photon when the electrons are excited.
  - (B) Molecules emit a photon when the electrons are excited.
  - (C) Molecules emit a photon at the same energy when excited electrons return to the ground state.
  - (D) Molecules emit a photon at higher energy when excited electrons return to the ground state.
  - (E) Molecules emit a photon at lower energy when excited electrons return to the ground state.
11. Which is the most accurate concerning ion-selective electrodes (ISEs)?
- (A) Gas-specific membranes are necessary for oxygen and carbon dioxide electrodes.
  - (B) The pH electrode does not require a reference electrode.
  - (C) The calcium electrode does not require a reference electrode.
  - (D) The sodium electrode uses an ion-selective carrier (valinomycin).
  - (E) The ISE for urea uses immobilized urease.

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12. Which of the following statements is *TRUE*?
- (A) Size exclusion chromatography is best suited for separating analytes based on their solubility in the mobile solvent.
- (B) In liquid-solid chromatography, the stationary phase separates analytes based on size, shape and polarity.
- (C) Ion-exchange chromatography has a resin phase that is soluble to water and separation of the mixture is based on magnitude and charge of ionic species.
- (D) Partition chromatography is most appropriate to identifying analytes that may be distributed between two liquid phases.
- (E) The partition coefficient is measured and compared with standards in thin layer chromatography.
13. Under acidic conditions, an analyte protein of unknown molecular weight is known to possess multiple positive charges, between +5 and +8. A mixture containing this protein and others were subjected to capillary electrophoresis in 10 mM trifluoroacetic acid, and the eluate from the capillary was fed directly into the ionization source of an electrospray mass spectrometer. As the protein eluted from the capillary, the  $m/z$  range of the mass spectrometric detector was scanned, and peaks were observed at  $m/z$  values of 938, 1071, 1250, and 1500. What is the molecular weight of the protein?
- (A) 5628 (B) 10000 (C) 12000 (D) 7500 (E) 8568
14. The ionic strength of an aqueous 0.10 M  $\text{Pb}(\text{NO}_3)_2$  solution is
- (A) 0.10 M (B) 0.25 M (C) 0.30 M (D) 0.50 M (E) 0.60 M
15. In an experiment to determine riboflavin by fluorescence spectrometry, a series of riboflavin standards was analyzed and gave a calibration line with a slope of  $1000 \text{ ppm}^{-1}$  and  $y$ -intercept of 25. If a sample gave a fluorescence reading of 750, the riboflavin concentration (in ppm) of the sample is
- (A) 0.0750 (B) 0.0775 (C) 0.725 (D) 0.775 (E) 7.50
16. The reaction shown below is not balanced. If the reaction is balanced using the smallest whole number coefficients, the coefficient for  $\text{I}^-$  will be
- $$\underline{\quad} \text{H}^+ + \underline{\quad} \text{IO}_3^- + \underline{\quad} \text{I}^- \rightarrow \underline{\quad} \text{I}_2 + \underline{\quad} \text{H}_2\text{O}$$
- (A) 1 (B) 2 (C) 3 (D) 5 (E) 10

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17. Many enzyme reactions follow the Michaelis-Menten rate law shown below, where  $V$  and  $K_m$  are constants and  $[S]$  is the concentration of substrate that is undergoing a catalyzed reaction. When  $[S] \gg K_m$ , what is the apparent order of the reaction?

$$\text{Rate} = \frac{V[S]}{K_m + [S]}$$

- (A) Zero order  
 (B) One-half order  
 (C) First order  
 (D) Pseudo-first order  
 (E) Second order
18. The table below shows chromatographic data for the analysis of benzene using an ethylbenzene internal standard. What is the benzene concentration (x) of the sample in  $\mu\text{g/mL}$ ?

	Standard	Sample
[Benzene], $\mu\text{g/mL}$	50	x
[Ethylbenzene], $\mu\text{g/mL}$	10	10
Benzene peak area, mV.s	2500	2500
Ethylbenzene peak area, mV.s	1000	500

- (A) 10 (B) 25 (C) 50 (D) 100 (E) 250
19. Which of the following is true about the quantum yield for photodecomposition of a chromophore?
- (A) It depends on the intensity of the light source used for the photolysis.  
 (B) It depends on the duration of the light source used for the photolysis.  
 (C) It is the reciprocal of the fluorescence lifetime.  
 (D) It has a value of either 0 or 1, reflecting the quantum nature of photons.  
 (E) It is the ratio of the number of chromophores decomposed to the number of photons absorbed.
20. Methyl *t*-butyl ether (MTBE,  $\text{CH}_3\text{-O-C}(\text{CH}_3)_3$ ) is a controversial gasoline additive. Of the following techniques, which would be the best method to measure quantitatively trace amounts of MTBE in contaminated ground water.
- (A) Capillary electrophoresis  
 (B) Gas chromatography  
 (C) Atomic absorption spectroscopy  
 (D) Fluorescence spectroscopy  
 (E) NMR spectroscopy

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21. Which of the following is not a qualification for instrument?  
(A) DQ (B) IQ (C) MQ (D) OQ (E) PQ
22. Which of the following instrument uses monochromator as information sorter?  
(A) Photometer  
(B) Atomic emission spectrometer  
(C) Coulometer  
(D) pH meter  
(E) Mass spectrometer
23. Which of the following does not contribute to a successful calibration curve?  
(A) Accurate known analyte concentration  
(B) Corrected instrumental response  
(C) Coefficient of linearity  $> 0.995$   
(D) Highly sensitive instrument  
(E) Match of matrix between sample and standard
24. Which of the following is not an instrumental noise?  
(A) Chemical noise  
(B) Environmental noise  
(C) Flicker noise  
(D) Shot noise  
(E) Thermal noise
25. Which of the following is not a signal-to-noise enhancement approach?  
(A) Digital filtering  
(B) Ensemble averaging  
(C) Grounding and shielding  
(D) Modulation  
(E) All of the above
26. Which of the following relaxation processes is the fastest?  
(A) Electronic relaxation  
(B) Fluorescence relaxation  
(C) Non-radiative relaxation  
(D) Phosphorescence relaxation  
(E) Vibrational relaxation

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27. The decimal equivalent of binary number 1011000110 is  
(A) 130 (B) 257 (C) 304 (D) 710 (E) 11111
28. Which of the following spectroscopy uses line sources?  
(A) Atomic absorption spectroscopy  
(B) Infrared spectroscopy  
(C) Mass spectroscopy  
(D) Molecular fluorescence spectroscopy  
(E) Visible spectroscopy
29. Which of the following atomizer offers the highest atomization temperature?  
(A) Electrothermal vaporization  
(B) Inductively coupled argon plasma  
(C) Microwave-induced argon plasma  
(D) Electric arc  
(E) Electric spark
30. Which of the following process is the undesired process during atomization?  
(A) Desolvation  
(B) Dissociation  
(C) Ionization  
(D) Nebulization  
(E) Volatization
31. Which of the following method detects the largest number of elements at concentration lower than 1 ppb?  
(A) Flame atomic absorption  
(B) Flame atomic emission  
(C) Flame atomic Fluorescence  
(D) Atomic X-ray emission  
(E) Inductively coupled emission
32. Which of the following is not a potential mass interference in the mass range for  $^{65}\text{Cu}$  determination?  
(A)  $^{32}\text{S}$  (B)  $^{33}\text{S}$  (C)  $^{33}\text{SO}_2$  (D)  $^{48}\text{CaOH}$  (E) None of the above
33. Which of the following is not applicable to atomic X-ray spectrometry?  
(A) Absorption (B) Diffraction (C) Fluorescence (D) Scattering (E) Transmission

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34. Which of the following is not a limitation to Beer's Law?
- (A) Chemical deviations
  - (B) Polychromatic Radiation
  - (C) Stray Radiation
  - (D) Mismatched Cells
  - (E) None of the above
35. Which of the following is commonly used to calibrate an infrared spectrometer?
- (A) KBr pellet
  - (B) NaCl pellet
  - (C) Polyethylene film
  - (D) Polystyrene film
  - (E) fluorinated hydrocarbon
36. Which of the following change in molecule causes the rise of Raman bands?
- (A) Dipole moment
  - (B) Electronic energy state
  - (C) Polarizability
  - (D) Rotational energy state
  - (E) Vibrational state
37. Which of the following mass spectrometry is mostly suitable for analyzing high molecular weight compounds?
- (A) Electron ionization
  - (B) Chemical ionization
  - (C) Electrospray ionization
  - (D) Fast atom bombardment
  - (E) Matrix-assisted desorption/ionization
38. Which of the following exhibits least effect on chromatographic band broadening?
- (A) Eddy diffusion
  - (B) Longitudinal diffusion
  - (C) Adsorption into stationary phase
  - (D) Desorption from stationary phase
  - (E) Mobile phase flow rate

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39. Which of the following exhibits highest sensitivity towards chlorinated pesticides?
- (A) Electron capture detector
  - (B) Flame ionization detector
  - (C) Fourier Transform IR
  - (D) Mass spectrometer
  - (E) Photoionization detector
40. Which of the following is the most often used thermal analysis method, preliminary owing to its speed, simplicity, and availability?
- (A) Differential thermal analysis
  - (B) Differential scanning calorimetry
  - (C) Evolved gas analysis
  - (D) Microthermal analysis
  - (E) Thermogravimetric analysis

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