LAB-MATH TEST FOR LIFE SCIENCES - CURRICULUM

Section 1. Numbers, Units and Measurements

1. Talking about Numerical data
2. Exponents, Common Lorgarithms and Application
3. Scientific Notation and Manipulation of Expression
4. Calculations with Scientifc Notation
5. Units of Measurement
6. Converting from One metric Unit to Another
7. Metric Prefixes for Large Numbers
8. Reading Measurements, Uncertain and Significant digits
9. Calculations and Significant Digits

Section 2. Preparation of Laboratory Solutions and Buffers

10. Solutions
11. What is the difference between amount and concentration of a solute in a solution?
12. Formula weight versus Molecular weight
13. Preparation of Stock Solutions from Solid Solutes
14. Dilution of Stock Solutions, Serial Dilutions
15. Molarity and Normality of Solutions
16. Percentage Solutions
17. Expression of PPM
18. Preparation of liquid solute based solutions
19. Density, Specific Gravity and Percentage Purity
20. Heterogenous mixture solutions and their importance in Biology
21. pH

22. Preparation of Laboratory Buffers, Handersen-Haselbach Equation

Section 3. Absorption Spectroscopy: Beer-Lambert's Law

23. Absorption Spectrophotometry

24. The Beer-Lambert Equation

25. Using Beer’s Law to Determine the Concentration of an Unknown Solution

26. Absorbance and Transmittance in a Spectrophotometer

27. Plate Reader Problem

28. Absorption of Environmental Pollutants by Organisms

29. Molar Extinction Coefficient

Section 4. Quantification of DNA, RNA

30. Introduction and Brief Review of Nucleic Acid Structure

31. Spectrophotometric Analysis of DNA and RNA

32. Determing Sigle and double Stranded DNAs Concentration by Spectrophotometry

33. Calculations and Manipulations of Nucleic Acids

34. Units of "Bases", Amount and Concentration

35. The Molecular Weights of Oligonucleotides

36. The Molecular Weight of DNA based on Fragment Length

37. Determining relative MW of Single stranded DNA

38. Determining relative MW of Double stranded DNA

39. Determining relative MW of Single stranded RNA

40. Quantitation of DNA using Gel electrophoresis

41. Calculating Amount of DNA frament Recovered from the Gel

Section 5. Molecular Biology

42. Restriction Digests

43. Setting up Restriction digests

44. Agarose Gel Electrophoresis

45. Analysis of the Size of the Fragments in an Agarose Gel

46. Determining How much DNA to load onto an Agarose gel

47. Determining Tm- Melting Temperature

48. Choosing Hybridization and Annealing Temp based on Tm

49. Using Tm to Calculate Base pair Composition

50. Specific Activity of a Radiolabeled Probe

51. Calculating Ends per picomole of Linear DNA

52. Introduction and Overview of the Components of a PCR

53. PCR is an Enzymatic Reaction

54. Setting up a PCR Amplification: Overview

55. PCR: Reaction Buffer

56. PCR: Primers

57. PCR: Nucleotides

58. PCR: Enzyme

59. PCR: Template

60. PCR: Magnesium

Section 6. Proteins: Quantification, Purification, Analysis and Enzyme Kinetics

61. Introduction

62. Assays of Total Protein

63. Assays of Specific Proteins

64. Amount and Concentration of Proteins- Spectrophotometry

65. Several Methods of Determing Molecular Weight of Proteins

66. Calculating MW from Aino acid Sequence

67. MW: From SDS-PAGE

68. Deciding how much Protein to load on a Polyacrylamide Gel

69. MW: Using Gel Filtration Chromatography

70. Protein/Enzyme Purification

71. Summarizing the Results of a Purification Procedure

72. Calculations of Purification Factor and Yield

73. Quantifying Protein/Enzyme Activity, Specific and Total Activities

74. An Example of Specific enzyme Assay: The β-Galactosidase

75. Footnote: The β-Galactosidase Formula

76. Fluorescence Resonance Energy Transfer (FRET)

77. Enzyme kinetics: Vmax, Km

78. Competitive, Uncompetitive and Non-Competitive Inhibitions and Ki

79. Allosteric Interactions and Activations

Section 7. Radioactive Isotopes, Decay and Scintillation Counting

80. Hot Stuff!

81. The Decay of Radioisotopes

82. Measuring Radioactivity, Geiger-Mulleer ans Scintillation Counters

Sction 8. Centrifugation

83. Centrifugation: Introduction

84. Rotors and Centrifugal Force

85. Separating Components using Centrifuges

Section 9. Cell Culture, Bacterial, Animal, Plant and Viral

86. Introduction

87. Simple Cell Splits

88. Counting Cells and Hemocytometer

89. Calculating Cell Density and Seeding Plates at Specific Cell densities

90. Determining Percent Viability of Cells

91. Test for Endotoxin: A Serial Dilution Problem

92. Bacterial, Animal, Plant Cell Culture

93. Viral Innoculum and (HIV) Quantification

94. Saving the Cell Culture or Cryoprotection

95. Transformation efficiency

96. Flowcytometer

Section 10. Pharmacology

97. Dosages

98. Determining Therapeutic Dose of a Drug

99. Pharmacokinetics

100. Pharmacodynamics

101. Bioavailability

Section 11. Graphical Methods of Presenting Data

102. Reporting and Presenting Numerical data: Graphs etc.

103. Using Graphs to display the Results of an Experiment

104. Brief Reviewing of the Basic techniques of Graphing

105. Describing Relationships with Equations and Graphs

106. Statistical Relationships: Regression and Correlation

107. Graphing Linear Equations

108. Graphing Straight Lines

109. An Application of Graphing: Standard Curves and Quantitative Analysis

110. A Statistical Method to Calculate the Line of the Best Fit

111. Graphing Exponential Equations

112. Exponential Relationships: Growth of Microorganisms

113. Semilog Paper

Section 12. Statistics and Descriptive Statistics

114. Introduction and Terminology

115. Descriptive Statistics: Measures of Central Tendency and Dispersion

116. Using Measures of dispersion to describe the Variability of a Series of Measurements

117. Calculating the Range, Variance and Standard deviation

118. Distributing between the Variance and Standard deviation of a Population and a Sample

119. The Coefficient of Variation (Relative Standard Deviation)

120. Descriptive Statistics of Data: Interpretation and Comparison

121. Statistical Significance and Confidence Intervals

122. Designing Experiments- Sample Size and Subject Allocation

123. Designing Experiments- Choosing Your Statistic