## Table of contents

Dedication ..... IX
Introduction ..... XI
Curriculum Vitae ..... XIII
What is required to complete this workbook? ..... XV
Assignment \#1
Documentation of the bullet holes in the wall Photographs ..... 1
Rough Sketches ..... 5
Measurements ..... 6
Tables to record the data from the documentation of the holes ..... 8
Assignment \#2
Different ways of determining the entrance impact angles ..... 9
Determining the entrance impact angles by the shape of the holes ..... 10
Caution about determining the entrance impact angle ..... 12
Determining the entrance impact angles by a protractor ..... 13
Determining the entrance impact angles by a Smart Level ..... 15
Determining the entrance impact angles by an Angle Finder ..... 16
Determining the entrance impact angles by Scaled Drawings ..... 17
Mathematics (angles) review ..... 27
Mathematics (intersecting lines) review ..... 29
Mathematics (parallel lines intersected by a straight line) review ..... 31
Mathematics (triangles) review ..... 35
Mathematics (right-angled triangles) review ..... 38
Mathematics (trigonometric ratios) review ..... 41
Making what you want to find the subject of the equation ..... 42
Determining the impact angles by calculations (examples) ..... 46
Determining the impact angles by calculations ..... 49
Comparison of the vertical impact angles (different methods) ..... 55
Comparison of the impact angles to the horizontal plane (different methods) ..... 56
Comparison of the horizontal impact angles (different methods) ..... 57
Calculating the percentage error for each method for each angle ..... 58
Different ways of determining the location of the muzzle of the gun ..... 59
Downward (sloped) or Upward (inclined) angles to the horizontal plane ..... 60
Assignment \#3
Determining the heights of the muzzle of the gun by theuse of the strings61
Assignment \#4Determining the distances from the muzzle of the gun tothe holes in the wall by the use of strings64
Assignment \# 5Determining the heights of the muzzle of the gun by theuse of scaled drawings68
Assignment \#6Determining the distances from the muzzle of the gun tothe holes in the wall by the use of scaled drawings73
Assignment \#7Example of how to calculate the heights of the muzzle ofthe gun for the corresponding horizontal distances79
Determining the heights of the muzzle of the gun by calculations ..... 80
Assignment \#8Example of how to calculate the distances from the muzzle ofthe gun to the holes for the corresponding horizontal distances85
Determining the distances from the muzzle of the gun to the holes in the wall by calculations ..... 86
Comparison of the heights of the muzzle of the gun and the distances from the muzzle of the gun to the three holes for the corresponding horizontal distances (\#3 through \#8) ..... 91
Assignment \#9Determining the horizontal distances from the muzzle ofthe gun to the wall for the muzzle heights of 48,54 and60 inches by the use of strings94
Assignment \#10
Example of how to draw the scaled diagrams ..... 97Determining the horizontal distances from the muzzle ofthe gun to the wall for the muzzle heights of 48,54 and60 inches by the use scaled drawings98
Assignment \#11Example of how to calculate the horizontal distances fromthe muzzle to the wall for the given muzzle heights ( $48,54 \& 60 \mathrm{ins}$ ) 101Determining the horizontal distances from the muzzle ofthe gun to the wall for the muzzle heights of 48,54 and60 inches by calculations103
Assignment \#12Determining the distances from the muzzle of the gun tothe holes in the wall for the muzzle heights of 48,54 and60 inches by the use of strings106
Assignment \#13
Example of how to draw the scaled diagrams ..... 109
Determining the distances from the muzzle of the gun to the holes in the wall for the muzzle heights of 48,54 and 60 inches by the use of scaled drawings ..... 110
Assignment \#14
Example of how to calculate the distances from the muzzle of the gun to the holes for the given muzzle heights ( $48,54 \& 60 \mathrm{ins}$ ) ..... 113
Determining the distances from the muzzle of the gun tothe holes in the wall for the muzzle heights of 48,54 and60 inches by calculations115
Comparison of the horizontal distances at the corresponding muzzle heights for the three holes (assignments \#9 through \#11) ..... 118
Comparison of the distances from the muzzle of the gun to the holes at the corresponding muzzle heights for the three holes (\#12 through \#14) ..... 119
Assignment \#15Determining the horizontal perpendicular distances fromthe muzzle of the gun to wall by the string method usingthe average or mean horizontal distances (page 118)alongthe path of projectile for the muzzle heights of 48,54 and60 inches120
Assignment \#16Example of how to draw the scaled diagrams123Determining the horizontal perpendicular distances fromthe muzzle of the gun to wall by the scaled drawing methodusing the average or mean horizontal distances (page 118along the path of projectile for the muzzle heights of 48,54and 60 inches124
Assignment \#17
Example of how to calculate the perpendicular distances ..... 127
Determining the horizontal perpendicular distances from the muzzle of the gun to wall by calculations using the average or mean horizontal distances (page 118)along the path of projectile for the muzzle heights of 48,54 and 60 inches ..... 128
Assignment \# 18Determining by the string method the horizontal distancesalong the wall from the holes to the intersection of thecorresponding horizontal perpendicular distances (\#15)131
Assignment \#19
Example of how to draw the scaled diagrams ..... 134
Determining by scaled drawings the horizontal distances along the wall from the holes to the intersection of the corresponding horizontal perpendicular distances (\#15) ..... 135
Assignment \#20
Example of how to calculate the horizontal distances along the front of the wall ..... 138
Determining by calculations the horizontal distances along the wall from the holes to the intersection of the corresponding horizontal perpendicular distances (\#15) ..... 139
Comparison of the horizontal perpendicular distances from the muzzle of the gun to the extended string / line along the front of the wall for the three holes (assignment \#15 through \#17) ..... 142
Comparison of the horizontal distances along the front of the wall from the holes to the intersection of the perpendicular horizontal and extended string line at the front of the wall for the three holes (assignments \#18 through \#20) ..... 143
Assignment \#21Classroom assignment to determine the downward impactangle to the horizontal plane, the horizontal angle and thefour distances144
Assignment \# 22Outside assignment using your vehicle to determine the sameInfo. as assignment \#21146
Assignment \# 23
Determine the corresponding heights for the horizontal ..... 147 distances
Assignment \# 24
Demonstration using the protractor with attached laser ..... 149
Trigonometric Ratios ..... 150
Squares and Square Roots ..... 152

