

TABLE OF CONTENTS

Lesson	Page
1. VEHICLE BEHAVIOR INVOLVING PHYSICS (Vehicle Mechanics and Dynamics)	1
Lesson Contents	1
Lesson Objectives	2
Lesson:	
Physics As It Pertains to Accident Investigation	3
Physics Defined	3
Newton's Laws of Motion	3
Newton's First Law	3
Newton's Second Law	4
Newton's Third Law	5
Gravity	6
Mass and Weight	6
Force	8
Centrifugal Force	8
Centripetal Force	8
Momentum	9
Work	9
Kinetic Energy	9
Center of Mass	10
Vectors	10
Speed and Velocity Defined	11
2. COEFFICIENT OF FRICTION AND DRAG FACTOR	13
Lesson Contents	13
Lesson Objectives	13
Lesson:	
Definitions	15

Influences on Skid Distance	17
Methods and Procedures	18
Determining Drag Factor	18
Grade or Slope	19
Test Skids	22
Procedures for Conducting Test Skids	22
Speedometer Accuracy Test	24
Longest Skid Mark	26
Averaging Skid Marks	27
Drag Sleds	28
Drag Factor Adjustments	34
Roadway Coefficient of Friction (Drag Factor) Guide	36
3. SLIDE-TO-STOP SPEED	37
Lesson Contents	37
Lesson Objectives	38
Lesson:	
Introduction	39
Skid Marks and Their Measurement	40
Factors	41
Types of Skid Marks	43
Effects of Weight Shift	48
Slide-to-Stop Speed Calculations	49
Speed from Skid Marks When Vehicle Has Partial Braking Capability	52
Speed Calculation with Continuous Skid on Different Type Surfaces	59
Speed Calculations from Skid Marks When Each Side of Vehicle Skids on Different Types of Roadway Surfaces	62
Special Speed Problems	64

4. SPEED FROM YAW MARKS, FALLS, VAULTS, FLIPS AND VAULTS, AND COMBINED SPEEDS	67
Lesson Contents	67
Lesson Objectives	68
Lesson:	
Part 1 -- Speed from Yaw Marks	69
Yaw	69
Yaw Mark Measurements	71
Speed Calculations Based on Yaw Marks and Vehicle Sliding Off Curve	77
Center of Mass	83
Part 2 -- Airborne Speeds	85
Falls, Flips and Vaults	85
Measurements	88
Falls	89
Flips and Vaults	93
Part 3 -- Combined Speeds	101
Combined Speed Formula	101
5. ACCELERATION AND DECELERATION	111
Lesson Contents	111
Lesson Objectives	112
Lesson:	
Speed and Speed Change	113
Constant Speed and Velocity	113
Average Speed and Velocity	113
Acceleration and Deceleration	114
Newton's Second Law of Motion	115
Constant Acceleration	115
Converting Velocity (ft/sec or m/s) to Speed (mph or km/h)	120
Converting Speed (mph or km/h) to Velocity (ft/sec or m/s)	121

Calculating Distance When Time and Speed or Velocity Are Known	122
Acceleration from a Stop	125
Acceleration Rate	131
Acceleration Factor	133
Acceleration from a Known Speed	136
Time for Acceleration from a Known Speed	138
Deceleration Rate and Drag Factor	138
Time Required to Slide (Skid) to a Given Point or to a Stop When Slide Distance and Drag Factor Are Known	141
Skid Distance Required to Stop When Initial Speed and Drag Factor Are Known	145
6. MOMENTUM SPEED ANALYSIS USING THE 360-DEGREE METHOD .	147
Lesson Contents	147
Lesson Objectives	148
 Lesson:	
Introduction to Momentum	149
Newton's Three Laws of Motion	149
Mass	150
Velocity	150
Conservation of Linear Momentum	152
Weight	153
Force	155
Impulse and Force	156
Energy	158
Elastic and Nonelastic Collisions	159
Vectors	159
The At-Scene Investigation	160
Momentum Speed Analysis Method	161
The 360-Degree Method	161
The Quadrant Method	162
The Cartesian Coordinate System	163

Momentum Speed Calculation Preparation	169
Field Sketch	170
Scale Diagram	171
Point of Separation	175
Vector Diagram	176
Y-Axis Component	179
X-Axis Component	180
Drag Factor Reduction	181
Examples: Conservation of Linear Momentum Speed	
Analysis	184
Example 1 (Two-vehicle angle collision)	184
Example 2 (Impact speed calculations involving negative sine and cosine values)	188
Example 3 (90-degree collision)	194
Example 4 (Rear-end in-line collision between two moving vehicles)	199
Example 5 (Rear-end in-line collision involving a moving vehicle that strikes a stopped vehicle)	202
Example 6 (Head-on in-line collision between two moving vehicles)	206
 RECOMMENDED READING	 215
 BIBLIOGRAPHY	 219
 INDEX	 221