



Contents

PART I Language Syntax

I Overview of PL/SQL	3
An Introduction to the PL/SQL Language	4
PL/SQL Syntax Fundamentals	7
Statements	8
Identifiers	8
Comments	8
Literals	9
Declaration Section	10
Variables	10
Datatypes	11
Constants	14
Other Declared Elements	14
Processing Section	15
Expressions	15
Assignment Statements	21
Conditional Statements	22
Loops	25
Cursors	28
Implicit Cursors	28
Explicit Cursors	30
Cursor Attributes	32
Loops Revisited: The Cursor FOR Loop	33

Advanced Datatype Declaration	34
%TYPE	34
%ROWTYPE	35
Exception-Handling Section	37
System-Defined Exceptions	38
User-Defined Exceptions	39
Working with Blocks	40
Nested Blocks	41
Scope: Declared Elements	42
Exception Scope and Exception Propagation	44
An Introduction to Program Units	47
Anonymous Blocks	47
Named Program Units	47
Chapter Summary	49
Two-Minute Drill	51
Chapter Questions	53
Answers to Chapter Questions	57
2 Procedures	61
Uses of Procedures	62
What Can You Do with Procedures?	63
Where Can You Store Procedures?	64
Creating, Altering, and Dropping Procedures	66
Creating Procedures	66
Altering Procedures	70
Dropping Procedures	72
Invoking Procedures	73
Executing a Procedure from a PL/SQL Block	73
Executing a Procedure from the SQL*Plus Command Line	74
Parameters	76
Parameter Declaration Syntax	76
Parameter Datatypes	77
Default Values	77
Parameter Types	78
Positional Notation versus Named Notation	83
Data Dictionary Resources for Procedures	85
USER_OBJECTS	86
USER_OBJECT_SIZE	88
USER_SOURCE	88
USER_ERRORS	89
SHOW ERRORS	91
Chapter Summary	93
Two-Minute Drill	95

Chapter Questions	96
Answers to Chapter Questions	100
3 Functions	103
Uses of Functions	104
Functions versus Procedures	105
Creating, Altering, and Dropping Functions	106
Creating Functions	106
Altering Functions	107
Dropping Functions	108
Invoking Functions	109
Functions Called from PL/SQL Expressions	110
Functions Called from SQL Statements	112
Client-Side Functions	113
Parameters	115
Passing Parameters by Reference	117
RETURN	119
Chapter Summary	123
Two-Minute Drill	123
Chapter Questions	124
Answers to Chapter Questions	129
4 Packages	133
Uses of Packages	134
Creating, Altering, and Dropping Packages	137
Creating a Package Specification	137
Creating a Package Body	139
Public versus Private Constructs	140
Global Constructs	141
Altering a Package	143
Dropping a Package	147
Changes to a Package Specification that Require a Change to the Body	149
Invoking Packaged Constructs	151
Referencing Packaged Constructs	151
Using Packaged Constructs	151
Data Dictionary Resources for Packages	156
Chapter Summary	158
Two-Minute Drill	159
Chapter Questions	160
Answers to Chapter Questions	164

5	Triggers	167
	Uses of Triggers	168
	Creating, Altering, and Dropping Triggers	170
	Creating Triggers	171
	The :old and :new Qualifiers	175
	Conditional Predicates	177
	Firing Rules	178
	Restrictions	179
	Altering Triggers	181
	Dropping Triggers	181
	Enabling and Disabling Triggers	183
	Disabling and Enabling a Named Trigger	183
	Enabling and Disabling a Named Table's Triggers	184
	INSTEAD OF Triggers	185
	Non-DML Triggers	188
	DDL Triggers	189
	Data Dictionary Resources for Triggers	190
	USER_TRIGGERS	191
	Chapter Summary	194
	Two-Minute Drill	195
	Chapter Questions	197
	Answers to Chapter Questions	200
6	Working with Program Units	203
	Client-Side versus Server-Side Program Units	204
	Invoking Server-Side Program Units	205
	Invoking Client-Side Program Units	206
	The Trade-of—Where to Put Them?	207
	Local Subprograms	209
	Forward Declarations	209
	Overloading	214
	Creating Overloaded Modules	215
	Namespaces for Program Units	217
	Initializing Variables with a One-Time-Only Procedure	219
	Functions and Purity Levels	221
	WNDS and RNDS	224
	WNPS and RNPS	224
	TRUST	225
	Purity Levels for the Package Initialization Section	225
	DEFAULT	226
	The Benefits of PRAGMA	226
	Persistent States	228
	Persistent Variables and Constants	228

Persistent Tables, Records, and Types	231
Persistent Cursors	232
Chapter Summary	237
Two-Minute Drill	238
Chapter Questions	239
Answers to Chapter Questions	243
7 Working with Oracle's PL/SQL Packages	245
DBMS_OUTPUT	247
SET SERVEROUTPUT ON	247
ENABLE and DISABLE	248
PUT_LINE, PUT, and NEW_LINE	248
GET_LINE and GET_LINES	249
DBMS_JOB	251
JOB_QUEUE_PROCESSES and JOB_QUEUE_INTERVAL	251
The SUBMIT Procedure	252
The REMOVE Procedure	253
The RUN Procedure	253
The CHANGE, NEXT_DATE, WHAT, INTERVAL, and INSTANCE Procedures	254
Other Procedures: USER_EXPORT, BROKEN, and ISUBMIT	254
Monitoring Batch Jobs with USER_JOBS	255
DBMS_DDL	257
The ALTER_COMPILE Procedure	257
The ANALYZE_OBJECT Procedure	258
Monitoring the Results of ALTER_COMPILE and ANALYZE_OBJECT	259
DBMS_PIPE	260
The PACK_MESSAGE Procedure	260
The SEND_MESSAGE Function	260
The RECEIVE_MESSAGE Function	261
The NEXT_ITEM_TYPE Function	262
The UNPACK_MESSAGE Procedure	262
Other Procedures	262
DBMS_SQL	263
The OPEN_CURSOR Function and the CLOSE_CURSOR Procedure	268
The PARSE Procedure	268
The DEFINE_COLUMN Procedure	269
The EXECUTE Function	270
The FETCH_ROWS Function	270
The COLUMN_VALUE Procedure	271
The BIND_VARIABLE Procedure	271

Native Dynamic SQL	272
Compilation Errors	273
Chapter Summary	274
Two-Minute Drill	275
Chapter Questions	276
Answers to Chapter Questions	278

PART II

Development Tools

8 Using Oracle PL/SQL Tools	283
SQL*Plus	284
The SQL*Plus Buffer Editor	287
Using Text Editors	289
Executing Text Files	291
PL/SQL Blocks and the Buffer	291
Procedure Builder	292
Object Navigator	294
Creating a Program Unit with Procedure Builder	298
Executing a Program Unit	305
Moving Program Units	306
Working with Libraries	307
Creating Database Triggers	308
Chapter Summary	310
Two-Minute Drill	311
Chapter Questions	312
Answers to Chapter Questions	315
9 Debugging PL/SQL	317
Debugging Concepts	318
Debugging Techniques	318
Code Formatting: An Example	320
Debugging Tools	321
Debugging with SQL*Plus	323
Debugging Compilation Errors with SQL*Plus	323
SHOW ERROR	328
Debugging Execution Errors in SQL*Plus	329
Debugging with Procedure Builder	330
Starting Debugger: Setting Breakpoints	331
Chapter Summary	340
Two-Minute Drill	340
Chapter Questions	341
Answers to Chapter Questions	344

PART III

Privileges and Interdependence

10	Managing Privileges	349
	System Privileges	350
	Roles	351
	System and Object Privilege Requirements for Program Units	353
	System Privileges for Program Units	353
	Object Privileges for Program Units	356
	Owner and Invoker Rights	358
	Owner Rights	358
	Invoker Rights	360
	Granting and Revoking Privileges	362
	Data Dictionary Resources	364
	SESSION_PRIVS	364
	SESSION_ROLES	365
	USER_SYS_PRIVS	365
	USER_ROLE_PRIVS	365
	DBA_SYS_PRIVS	366
	USER_TAB_PRIVS, USER_TAB_PRIVS_MADE, and USER_TAB_PRIVS_RECD	366
	Chapter Summary	368
	Two-Minute Drill	370
	Chapter Questions	371
	Answers to Chapter Questions	373
11	Managing Interdependencies	377
	Tracking Dependencies	378
	USER_DEPENDENCIES	378
	DEPTREE and IDEPTREE	382
	Dependency Issues Within a Single Database	386
	Dependency Issues Across Multiple Databases	388
	The Timestamp Mode	390
	The Signature Mode	390
	Avoiding Recompilation Errors	392
	Chapter Summary	394
	Two-Minute Drill	396
	Chapter Questions	396
	Answers to Chapter Questions	399

PART IV

Practice Exams

12 Practice Exams	403
Practice Exam #1	404
Answers to Practice Exam #1	425
Practice Exam #2	436
Answers to Practice Exam #2	452
Practice Exam #3	462
Answers to Practice Exam #3	478