Contents

1 Overview

Objectives 1-2 What Is Performance Management? 1-3 Who Manages Performance? 1-4 What Does the DBA Tune? 1-5 Types of Tuning 1-6 Tuning Methodology 1-7 Effective Tuning Goals 1-9 General Tuning Session 1-11 Tuning a CDB 1-13 Performance Tuning: Diagnostics 1-14 Performance Tuning: Features and Tools 1-15 Tuning Objectives 1-16 Summary 1-17 Practice Overview 1-18

2 Defining the Scope of Performance Issues

Objectives 2-2 Defining the Problem 2-3 Limit the Scope 2-4 Determining Tuning Priorities 2-5 Common Tuning Problems 2-6 Tuning Life Cycle Phases 2-8 Tuning During the Life Cycle 2-9 Application Design and Development 2-10 Testing: Database Configuration 2-11 Deployment 2-12 Production 2-13 Migration, Upgrade, and Environment Changes 2-14 ADDM Tuning Session 2-15 Performance Versus Business Requirements 2-16 Monitoring and Tuning Tools: Overview 2-17 Summary 2-19 Practice Overview 2-20

3 Using the Time Model to Diagnose Performance Issues

Objectives 3-2 Time Model: Overview 3-3 DB Time 3-4 CPU and Wait Time Tuning Dimensions 3-5 Time Model Statistics Hierarchy 3-6 Time Model: Example 3-8 Top Timed Events 3-9 Summary 3-10 Practice Overview 3-11

4 Using Statistics and Wait Events to Diagnose Performance Issues

Objectives 4-2 Dynamic Performance Views 4-3 Dynamic Performance Views: Usage Examples 4-4 Dynamic Performance Views: Considerations 4-5 Statistic Levels 4-6 Instance Activity and Wait Event Statistics 4-8 System Statistic Classes 4-9 Displaying Statistics 4-10 Displaying SGA Statistics 4-11 Wait Events 4-12 Using the V\$EVENT_NAME View 4-13 Wait Classes 4-14 Displaying Wait Event Statistics 4-15 Commonly Observed Wait Events 4-17 Using the V\$SESSION_WAIT View 4-18 Precision of System Statistics 4-19 Summary 4-20 Practice Overview 4-21

5 Using Log and Trace Files to Monitor Performance

Objectives 5-2 Viewing the Alert Log 5-3 Using Alert Log Information as an Aid in Managing Performance 5-5 Administering the DDL Log File 5-6 Understanding the Debug Log File 5-7 User Trace Files 5-8 Background Processes Trace Files 5-9 Summary 5-10 Practice Overview 5-11

6 Using Enterprise Manager Cloud Control and SQL Developer to Monitor Performance

Objectives 6-2 Enterprise Manager: Overview 6-3 Configuring Enterprise Manager Database Express 6-4 Oracle Enterprise Manager Cloud Control Components 6-5 Using Features of the Oracle Management Packs and Options 6-6 Oracle SQL Developer 6-7 SQL Developer Command Line (SQLcl) 6-8 Summary 6-9 Practice Overview 6-10

7 Using Statspack to View Performance Data

Objectives 7-2 Introduction to Statspack 7-3 Statspack Scripts 7-4 Installing Statspack 7-6 Capturing Statspack Snapshots 7-7 Configuring Snapshot Data Capture 7-8 Statspack Snapshot Levels 7-9 Statspack Baselines and Purging 7-11 Reporting with Statspack 7-12 Statspack Considerations 7-13 Statspack Reports 7-14 Reading a Statspack Report 7-15 Statspack Report Drilldown Sections 7-16 Report Drilldown Examples 7-18 Load Profile Section 7-19 Time Model Section 7-20 Statspack and AWR 7-21 Summary 7-22 Practice Overview 7-23

8 Using Automatic Workload Repository

Objectives 8-2 Automatic Workload Repository: Overview 8-3 Automatic Workload Repository Data 8-4 Workload Repository 8-5 AWR Administration 8-6 AWR Snapshot Purging Policy 8-7 Managing Snapshots with PL/SQL 8-8 AWR Snapshot Settings 8-9 Manual AWR Snapshots 8-10 Managing AWR Data in a Multitenant Environment 8-11 AWR Snapshots and ADDM in a Multitenant Architecture Database 8-12 Generating AWR Reports 8-13 Reading the AWR Report 8-14 AWR Report: Multitenant Data 8-15 Generating AWR Reports by Using SQL*Plus 8-16 Statspack and AWR Reports 8-17 Reading a Statspack or an AWR Report 8-18 Compare Periods: Benefits 8-19 Snapshots and Periods Comparisons 8-20 Compare Periods: Results 8-21 Compare Periods: Report 8-22 Multitenant AWR Views 8-23 Summary 8-24 Practice Overview 8-25

9 Using Metrics and Alerts

Objectives 9-2 Metrics and Alerts 9-3 Limitation of Base Statistics 9-4 Typical Delta Tools 9-5 Oracle Database Metrics 9-6 Benefits of Metrics 9-7 Viewing Metric History Information 9-8 Viewing Metric Details 9-9 Statistic Histograms 9-10 Histogram Views 9-11 Server-Generated Alerts 9-12 Alert Usage Model 9-13 Metric and Alert Views 9-14 Summary 9-15 Practice Overview 9-16

10 Using Baselines

Objectives 10-2 Comparative Performance Analysis with AWR Baselines 10-3 Automatic Workload Repository Baselines 10-4 AWR Baselines 10-5 Types of Baselines 10-6 Moving Window Baseline 10-7 Baselines in Performance Page Settings 10-8 Baseline Templates 10-9 Creating AWR Baselines 10-10 Creating a Single AWR Baseline 10-11 Creating a Repeating Baseline and Template 10-12 Managing Baselines by Using the DBMS_WORKLOAD_REPOSITORY Package 10-13 Generating a Baseline Template for a Single Time Period 10-14 Creating a Repeating Baseline Template 10-15 Baseline Views 10-16 Performance Monitoring and Baselines 10-17 Defining Alert Thresholds by Using a Static Baseline 10-19 Configuring a Basic Set of Thresholds 10-20 Summary 10-21 Practice 3 Overview: Using AWR Baselines 10-22

11 Managing Automated Maintenance Tasks

Objectives 11-2 Automated Maintenance Tasks 11-3 Maintenance Windows 11-4 Default Maintenance Plan 11-5 Automated Maintenance Task Priorities 11-6 Configuring Automated Maintenance Tasks 11-7 Summary 11-8 Practice Overview 11-9

12 Using ADDM to Analyze Performance

Objectives 12-2 ADDM Performance Monitoring 12-3 ADDM and Database Time 12-4 DB Time-Graph and ADDM Methodology 12-5 Top Performance Issues Detected 12-7 ADDM Recommendations 12-8 Creating a Manual ADDM Task 12-9 ADDM Tasks in a Multitenant Architecture Database 12-10 Changing ADDM Attributes 12-11 Retrieving ADDM Reports by Using SQL 12-12 Compare Periods ADDM: Analysis 12-13 Workload Compatibility 12-14 Configuring Automatic ADDM Analysis at the PDB Level 12-15 Using the DBMS_ADDM Package to Compare Periods 12-16 Example: Using the DBMS_ADDM Package to Compare Periods 12-17 Summary 12-18 Practice Overview 12-19

13 Using Active Session History Data for First Fault System Analysis

Objectives 13-2 Active Session History: Overview 13-3 Active Session History: Mechanics 13-4 ASH Sampling: Example 13-5 Accessing ASH Data 13-6 Analyzing the ASH Data 13-7 Using Enterprise Manager to Generate ASH Reports 13-8 Using the ASH Report Script to Generate a Report 13-9 ASH Report Structure 13-10 Determining the Source of Data 13-11 Performing Skew Analysis 13-12 Additional Automatic Workload Repository Views 13-13 Summary 13-14 Practice Overview 13-15

14 Using Emergency Monitoring and Real-Time ADDM to Analyze Performance Issues

Objectives 14-2 Emergency Monitoring: Challenges 14-3 Emergency Monitoring: Goals 14-4 Using Real-Time ADDM to Perform a Root-Cause Analysis 14-5 Using Real-Time ADDM 14-6 Real-Time ADDM in the Database 14-7 Using Real-Time ADDM 14-9 Viewing Real-Time ADDM Results 14-10 Summary 14-11

15 Overview of SQL Statement Processing

Objectives 15-2 SQL Statement Processing Phases 15-3 Parsing 15-4 SQL Cursor Storage 15-5 Session Cursor Cache 15-6 Cursor Usage and Parsing 15-7 SQL Statement Processing Phases: Bind 15-8 SQL Statement Processing Phases: Execute and Fetch 15-9 Processing a DML Statement 15-10 Commit Processing 15-12 Identifying Poorly Performing SQL Statements 15-13 Top SQL Reports 15-14 SQL Monitoring 15-15 Monitored SQL Execution Details 15-16 Summary 15-17

16 Maintaining Indexes

Objectives 16-2 Creating Indexes 16-3 Using Invisible and Unusable Indexes 16-4 Dropping Indexes 16-5 Reducing the Cost of SQL Operations 16-6 Index Maintenance 16-7 Using Advanced Index Compression 16-9 Other Index Options 16-10 SQL Access Advisor 16-11 Quiz 16-12 Automatic Indexing Task 16-13 Automatic Index Task Workflow 16-15 Automatic Indexing Task Reporting 16-16 Automatic Indexing Views 16-17 Summary 16-18 Practice Overview 16-19

17 Maintaining Tables

Objectives 17-2 Reducing the Cost of SQL Operations 17-3 Table Maintenance for Performance 17-4 Table Reorganization Methods 17-5 Space Management 17-6 Extent Management 17-7 Locally Managed Extents 17-8 Large Extents: Considerations 17-9 How Table Data Is Stored 17-11 Anatomy of a Database Block 17-12

Minimize Block Visits 17-13 Block Allocation 17-14 Free Lists 17-15 Block Space Management 17-16 Block Space Management with Free Lists 17-17 Automatic Segment Space Management 17-19 Automatic Segment Space Management at Work 17-20 Block Space Management with ASSM 17-21 Creating an Automatic Segment Space Management Segment 17-22 Migration and Chaining 17-23 Guidelines for PCTFREE and PCTUSED 17-25 Detecting Migration and Chaining 17-26 Selecting Migrated Rows 17-27 Eliminating Migrated Rows 17-28 Shrinking Segments: Overview 17-30 Shrinking Segments: Considerations 17-31 Shrinking Segments by Using SQL 17-32 Segment Shrink: Basic Execution 17-33 Segment Shrink: Execution Considerations 17-34 Data Compression 17-35 Advanced Row Compression: Overview 17-37 Advanced Row Compression: Concepts 17-38 Using Advanced Row Compression 17-39 Advanced Row Compression for DML Operations 17-40 Advanced Index Compression 17-41 How Does Hybrid Columnar Compression Work? 17-42 Using the Compression Advisor 17-43 Using the Compression Advisor for Indexes 17-44 Viewing Table Compression Information 17-45 Quiz 17-46 Summary 17-47 Practice Overview 17-48

18 Introduction to Query Optimizer

Objectives 18-2 Role of the Oracle Optimizer 18-3 Functions of the Query Optimizer 18-5 Selectivity 18-7 Cardinality and Cost 18-8 Changing Optimizer Behavior 18-9 Setting and Viewing Optimizer Parameters 18-10 Using Initialization Parameters to Control Optimizer Behavior 18-11 Enabling Query Optimizer Features 18-13 Influencing the Optimizer Approach 18-14 Optimizing SQL Statements 18-15 Access Paths 18-16 Choosing an Access Path 18-17 Summary 18-18

19 Understanding Execution Plans

Objectives 19-2 What Is an Execution Plan? 19-3 Methods for Viewing Execution Plans 19-4 Uses of Execution Plans 19-5 DBMS_XPLAN Package: Overview 19-6 EXPLAIN PLAN Command 19-8 EXPLAIN PLAN Command: Example 19-9 EXPLAIN PLAN Command: Output 19-10 Reading an Execution Plan 19-11 Using the V\$SQL_PLAN View 19-12 Querying V\$SQL_PLAN 19-13 V\$SQL_PLAN_STATISTICS View 19-14 Querying the AWR 19-15 SQL*Plus AUTOTRACE 19-16 Using SQL*Plus AUTOTRACE 19-17 SQL*Plus AUTOTRACE: Statistics 19-18 Quiz 19-19 Adaptive Execution Plans 19-20 Dynamic Plans 19-21 Dynamic Plan: Adaptive Process 19-22 Dynamic Plans: Example 19-23 Continuous Adaptive Query Plans 19-24 Automatic Re-Optimization 19-25 Comparing Execution Plans 19-26 Summary 19-27 Practice Overview 19-28

20 Viewing Execution Plans by Using SQL Trace and TKPROF

Objectives 20-2 SQL Trace Facility 20-3 How to Use the SQL Trace Facility 20-5 Initialization Parameters 20-6 Enabling SQL Trace 20-8 Disabling SQL Trace 20-9 Formatting Your Trace Files 20-10 TKPROF Command Options 20-11 Output of the TKPROF Command 20-13 TKPROF Output with No Index: Example 20-18 TKPROF Output with Index: Example 20-19 Generating an Optimizer Trace 20-20 Summary 20-21 Practice Overview 20-22

21 Managing Optimizer Statistics

Objectives 21-2 **Optimizer Statistics** 21-3 Types of Optimizer Statistics 21-4 **Optimizer Statistics Collection** 21-5 Dynamic Statistics 21-7 Gathering Statistics and Setting Optimizer Statistics Preferences 21-8 Setting Statistic Preferences 21-9 Viewing and Managing Optimizer Statistics Preferences 21-11 Extended Statistics 21-12 Maintaining Optimizer Statistics 21-13 Automated Maintenance Tasks 21-14 Optimizer Statistics Advisor 21-15 Optimizer Statistics Advisor Report 21-16 Executing Optimizer Statistics Advisor Tasks 21-17 Restoring Statistics 21-18 Deferred Statistics Publishing: Overview 21-19 Deferred Statistics Publishing: Example 21-21 Managing Real-Time Statistics 21-22 Configuring High-Frequency Automatic Optimizer Statistics Collection 21-23 Summary 21-24 Practice Overview 21-25

22 Using Automatic SQL Tuning

Objectives 22-2 Automatic SQL Tuning: Overview 22-3 SQL Statement Profiling 22-4 Plan Tuning Flow and SQL Profile Creation 22-5 SQL Tuning Loop 22-6 Using SQL Profiles 22-7 Summary 22-8

23 Using the SQL Plan Management Feature

Objectives 23-2 SQL Plan Management: Overview 23-3 SQL Plan Baseline: Architecture 23-4 Loading SQL Plan Baselines 23-5 Loading SQL Plan Baselines from AWR 23-6 Evolving SQL Plan Baselines 23-7 Adaptive SQL Plan Management 23-8 Automatically Evolving SQL Plan Baseline 23-9 Including Alternate Plans in the SPM Evolve Advisor List 23-10 Important Baseline SQL Plan Attributes 23-11 SQL Plan Selection 23-12 Possible SQL Plan Manageability Scenarios 23-13 SQL Performance Analyzer and SQL Plan Baseline Scenario 23-14 Loading a SQL Plan Baseline Automatically 23-15 Purging SQL Management Base Policy 23-16 Enterprise Manager and SQL Plan Baselines 23-17 Quiz 23-18 Summary 23-19 Practice Overview 23-20

24 Overview of the SQL Advisors

Objectives 24-2 SQL Tuning Process 24-3 SQL Tuning Advisor: Overview 24-4 SQL Access Advisor: Overview 24-6 SQL Performance Analyzer: Overview 24-7 Summary 24-9

25 Using the SQL Tuning Advisor

Objectives 25-2 SQL Tuning Advisor: Overview 25-3 SQL Tuning Advisor Architecture 25-6 Automatic Tuning Optimizer 25-7 Using the SQL Tuning Advisor 25-8 SQL Tuning Advisor Options 25-9 SQL Tuning Advisor Recommendations 25-10 Alternative Execution Plans 25-11 Summary 25-13 Practice Overview 25-14

26 Using the SQL Access Advisor

Objectives 26-2 SQL Access Advisor: Overview 26-3 Using the SQL Access Advisor 26-4 Viewing Recommendations 26-5 Viewing Recommendation Details 26-6 Summary 26-7 Practice Overview 26-8

27 Overview of Real Application Testing Components

Objectives 27-2 Real Application Testing: Overview 27-3 Real Application Testing: Use Cases 27-4 Summary 27-5

28 Using SQL Performance Analyzer to Determine the Impact of Changes

Objectives 28-2 SQL Performance Analyzer: Process 28-3 Steps 6-7: Comparing/Analyzing Performance and Tuning Regressed SQL 28-5 Capturing the SQL Workload 28-6 Creating a SQL Performance Analyzer Task 28-7 SQL Performance Analyzer Task Page 28-8 SQL Performance Analyzer: PL/SQL Example 28-9 Tuning Regressed SQL Statements 28-11 SQL Performance Analyzer: Data Dictionary Views 28-12 Quiz 28-13 Summary 28-14 Practice Overview 28-15

29 Using Database Replay to Test System Performance

Objectives 29-2 Using Database Replay 29-3 The Big Picture 29-4 System Architecture: Capture 29-5 System Architecture: Processing the Workload 29-7 System Architecture: Replay 29-8 Database Replay Workflow in Enterprise Manager 29-9 Accessing Database Replay in Enterprise Manager 29-10 Capture Considerations 29-11 Replay Considerations: Preparation 29-13 Replay Considerations 29-14 Replay Customized Options 29-15 Replay Analysis 29-16 Quiz 29-17 Database Replay Packages 29-18 Data Dictionary Views: Database Replay 29-19 Database Replay: PL/SQL Example 29-20 Calibrating Replay Clients 29-22 Capturing and Replaying in a CDB and PDBs 29-23 Reporting 29-24 Quiz 29-25 Summary 29-26 Practice Overview 29-27

30 Implementing Real-Time Database Operation Monitoring

Objectives 30-2 Overview 30-3 Use Cases 30-4 Defining a DB Operation 30-5 Scope of a Composite DB Operation 30-6 Database Operation Concepts 30-7 Identifying a Database Operation 30-8 Enabling Monitoring of Database Operations 30-9 Identifying, Starting, and Completing a Database Operation 30-10 Monitoring Database Operations in Sessions 30-11 Monitoring the Progress of a Database Operation 30-12 Monitoring Load Database Operations 30-13 Monitoring Load Database Operation Details 30-14 Database Operation View: V\$SQL_MONITOR 30-15 Database Operation Views 30-16 Reporting Database Operations by Using Functions 30-17 Database Operation Tuning 30-18 Summary 30-19 Practice Overview 30-20

31 Using Services to Monitor Applications

Objectives 31-2 What is a service? 31-3 Service Attributes 31-4

Service Types 31-5 Creating Services 31-6 Using the DBMS_SERVICE Package to Manage Services 31-7 Where are services used? 31-8 Using Services with Client Applications 31-9 Using Services with the Resource Manager 31-10 Using Enterprise Manager to Manage Consumer Group Mappings 31-11 Services and the Resource Manager: Example 31-12 Using Enterprise Manager to Create a Job Class 31-13 Using Enterprise Manager to Create a Job 31-14 Services and the Scheduler: Example 31-15 Using Services with Metric Thresholds 31-16 Using Enterprise Manager to Change Service Thresholds 31-17 Services and Metric Thresholds: Example 31-18 Service Aggregation and Tracing 31-19 Top Services Performance Page 31-20 Service Aggregation Configuration 31-21 Service Aggregation: Example 31-22 Client Identifier Aggregation and Tracing 31-23 Using the TRCSESS Utility 31-24 Service Performance Views 31-25 Summary 31-27 Practice Overview 31-28

32 Overview of Memory Structures

Objectives 32-2 Managing Memory Caches and Structures 32-3 Guidelines for Efficient Memory Usage 32-4 Summary 32-6 Practice Overview 32-7

33 Managing Shared Pool Performance

Objectives 33-2 Shared Pool Architecture 33-3 Shared Pool Operation 33-4 Library Cache 33-5 Latch and Mutex 33-6 Latch and Mutex: Views and Statistics 33-8 Diagnostic Tools for Tuning the Shared Pool 33-10 AWR/Statspack Indicators 33-11 Top Timed Events 33-12

Time Model 33-13 Load Profile 33-14 Instance Efficiencies 33-15 Library Cache Activity 33-16 Avoid Hard Parses 33-17 Are Cursors Being Shared? 33-18 Candidate Cursors for Sharing 33-19 Sharing Cursors 33-20 Adaptive Cursor Sharing: Example 33-21 Adaptive Cursor Sharing Views 33-23 Interacting with Adaptive Cursor Sharing 33-24 Reduce the Cost of Soft Parses 33-25 Quiz 33-26 Sizing the Shared Pool 33-27 Shared Pool Advisory 33-28 Shared Pool Advisory in an AWR Report 33-29 Shared Pool Advisor 33-30 Avoiding Fragmentation 33-31 Large Memory Requirements 33-32 Tuning the Shared Pool Reserved Pool 33-34 Keeping Large Objects 33-36 Data Dictionary Cache 33-38 Dictionary Cache Misses 33-39 SQL Query Result Cache: Overview 33-40 Managing the SQL Query Result Cache 33-41 Using the RESULT_CACHE Hint 33-43 Using Table Annotation to Control Result Caching 33-44 Using the DBMS_RESULT_CACHE Package 33-45 Viewing SQL Result Cache Dictionary Information 33-46 SQL Query Result Cache: Considerations 33-47 Summary 33-48 Practice Overview 33-49

34 Managing Buffer Cache Performance

Objectives 34-2 Buffer Cache: Highlights 34-3 Database Buffers 34-4 Buffer Hash Table for Lookups 34-5 Working Sets 34-6 Tuning Goals and Techniques 34-8 Symptoms of a Buffer Cache Issue 34-10

Cache Buffer Chains Latch Contention 34-11 Finding Hot Segments 34-12 Buffer Busy Waits 34-13 Buffer Cache Hit Ratio 34-14 Buffer Cache Hit Ratio is Not Everything 34-15 Interpreting Buffer Cache Hit Ratio 34-16 Read Waits 34-17 Free Buffer Waits 34-18 Solutions for Buffer Cache Issues 34-19 Sizing the Buffer Cache 34-20 Buffer Cache Size Parameters 34-21 Dynamic Buffer Cache Advisory Parameter 34-22 Buffer Cache Advisory View 34-23 Using the V\$DB_CACHE_ADVICE View 34-24 Using the Buffer Cache Advisor 34-25 Caching Tables 34-26 Automatic Big Table Caching 34-27 Configuring Automatic Big Table Caching 34-28 Using Automatic Big Table Caching 34-29 Monitoring Automatic Big Table Caching 34-30 Memoptimized Rowstore 34-31 In-Memory Hash Index 34-32 Multiple Buffer Pools 34-33 Enabling Multiple Buffer Pools 34-34 Calculating the Hit Ratio for Multiple Pools 34-35 Multiple Block Sizes 34-36 Multiple Database Writers 34-37 Multiple I/O Slaves 34-38 Using Multiple Writers and I/O Slaves 34-39 Private Pool for I/O-Intensive Operations 34-40 Automatically Tuned Multiblock Reads 34-41 Database Smart Flash Cache Overview 34-42 Using Database Smart Flash Cache 34-43 Database Smart Flash Cache Architecture Overview 34-44 Configuring Database Smart Flash Cache 34-45 Sizing Database Smart Flash Cache 34-46 Enabling and Disabling Flash Devices 34-47 Specifying Database Smart Flash Cache for a Table 34-48 Full Database In-Memory Caching 34-49 Setting Up Force Full Database Caching 34-50 Monitoring Full Database In-Memory Caching 34-51

Flushing the Buffer Cache (for Testing Only) 34-52 Summary 34-53 Practice Overview 34-54

35 Managing PGA and Temporary Space Performance

Objectives 35-2 SQL Memory Usage 35-3 Performance Impact 35-4 Automatic PGA Memory 35-5 SQL Memory Manager 35-6 Configuring Automatic PGA Memory 35-7 Setting PGA_AGGREGATE_TARGET Initially 35-8 Limiting the Size of the Program Global Area 35-9 Managing the PGA for PDBs 35-10 Monitoring SQL Memory Usage 35-11 Monitoring SQL Memory Usage: Examples 35-12 Tuning SQL Memory Usage 35-13 PGA Target Advice Statistics 35-14 PGA Target Advice Histograms 35-15 Automatic PGA and Enterprise Manager 35-16 Automatic PGA and AWR Reports 35-17 Temporary Tablespace Management: Overview 35-18 Temporary Tablespace: Locally Managed 35-19 Configuring Temporary Tablespace 35-20 Temporary Tablespace Group: Overview 35-22 Temporary Tablespace Group: Benefits 35-23 Creating Temporary Tablespace Groups 35-24 Maintaining Temporary Tablespace Groups 35-25 Viewing Tablespace Groups 35-26 Monitoring Temporary Tablespace 35-27 Shrinking a Temporary Tablespace 35-28 Using the Tablespace Option When Creating a Temporary Table 35-29 Quiz 35-30 Summary 35-31 Practice Overview 35-32

36 Configuring the Large Pool

Objectives 36-2 Large Pool Overview 36-3 Tuning the Large Pool 36-4 Summary 36-5

37 Using Automatic Shared Memory Management

Objectives 37-2 Oracle Database Architecture 37-3 Granules 37-4 Automatic Shared Memory Management: Overview 37-5 SGA Sizing Parameters: Overview 37-6 Dynamic SGA Transfer Modes 37-7 Memory Broker Architecture 37-8 Manually Resizing Dynamic SGA Parameters 37-9 Behavior of Auto-Tuned SGA Parameters 37-10 Behavior of Manually Tuned SGA Components 37-11 Using the V\$SYSTEM_PARAMETER View 37-12 Resizing SGA_TARGET 37-13 Disabling Automatic Shared Memory Management 37-14 Using the SGA Advisor 37-15 Monitoring ASMM 37-16 Managing SGA for PDBs 37-17 Summary 37-18 Practice Overview 37-19

38 Introduction to In-Memory Column Store

Objectives 38-2 Database In-Memory Feature Set 38-3 Goals of In-Memory Column Store 38-5 Benefits 38-7 Overview 38-8 Row Store Versus Column Store: 2D Vision 38-10 In-Memory Column Unit 38-11 Compare: In-Memory Column Store Cache and Buffer Cache 38-12 Dual Format In-Memory 38-13 Indexes Issues 38-14 Process 38-15 In-Memory Column Store: Dual Format of Segments in SGA 38-16 Summary 38-17

39 Configuring the In-Memory Column Store Feature

Objectives 39-2 Deploying IM Column Store 39-3 Deploying IM Column Store: Objects Setting 39-4 Deploying IM Column Store: Columns Setting 39-5 Defining IM Column Store Compression 39-6 In-Memory Advisor 39-7 IM Advisor or Compression Advisor? 39-8 Computing Compression Ratio 39-9 IM FastStart 39-10 Automatic In-Memory: Overview 39-11 AIM Action 39-12 Configuring Automatic In-Memory 39-13 Diagnostic Views 39-14 Summary 39-15 Practice Overview 39-16

40 Using the In-Memory Column Store Feature to Improve SQL Performance

Objectives 40-2 Query Benefits 40-3 Testing and Comparing Query Performance 40-4 Queries on In-Memory Tables: Simple Predicate 40-5 MINMAX Pruning Statistics 40-6 IM Column Store Statistics 40-7 Execution Plan: TABLE ACCESS IN MEMORY FULL 40-8 Queries on In-Memory Tables: Join 40-9 Execution Plan: JOIN FILTER CREATE / USE 40-10 Queries on In-Memory Tables: Join Groups 40-11 Population of Expressions and Virtual Columns Results 40-12 In-Memory Expression Unit (IMEU) 40-14 Populating In-Memory Expression Results 40-15 Populating In-Memory Expression Results Within a Window 40-17 Waiting for In-Memory Segments to be Populated 40-18 Views 40-19 Summary 40-20 Practice Overview 40-21

41 Using In-Memory Column Store with Oracle Database Features

Objectives 41-2 Interaction with Other Products 41-3 Optimizer 41-4 IM Column Store and Real Application Clusters 41-6 IM Column Store and Data Pump 41-7 Data Pump TRANSFORM Names 41-8 Automatic Data Optimization Interaction 41-9 Managing Heat Map and Automatic Data Optimization Policies 41-10 Creating ADO In-Memory Policies 41-12 Summary 41-13 Practice Overview 41-14