WACE Mathematics Applications ATAR Course

EP Curriculum Map

Please note that EP does not currently provide all necessary resources to meet the current WACE Mathematics Applications study design. Any specific content that is not currently covered by EP is highlighted in yellow.

Unit 1

Topic 1.1: Consumer arithmetic

Applications of rates and percentages

Specific Expectations	Lessons	
1.1.1 calculate weekly or monthly wage from an annual salary, wages from an hourly rate, including situations involving overtime and other allowances, and earnings based on commission or piecework	• Timesheets • Salaries and Wages • Overtime, Special Rates and Allowances • Commission • Piecework • Government Benefits and Allowances • Income in Retirement • Activity: Applying Government Benefits • Introduction to Budgets • Making a Budget • Review: Budgeting • Budgeting: Preparing a Personal Budget • Cost per Item • Best Buys Using Unit Costs	• Percentages Review • Percentages and Money • Calculating Discounts • Goods and Services Tax • Profit and Loss • Calculating Profit and Loss • Calculating Simple Interest • Compound Interest Basic Formula • Compound Interest - Months and Weeks • Saving for Retirement • Exchange Rates • Question Bank - Topic 1: Consumer Arithmetic
1.1.2 calculate payments based on government allowances and pensions		
1.1.3 prepare a personal budget for a given income taking into account fixed and discretionary spending		
1.1.4 compare prices and values using the unit cost method		
1.1.5 apply percentage increase or decrease in contexts, including determining the impact of inflation on costs and wages over time, calculating percentage mark-ups and discounts, calculating GST, calculating profit or loss in absolute and percentage terms, and calculating simple and compound interest		
1.1.6 use currency exchange rates to determine the cost in Australian dollars of purchasing a given amount of a foreign currency, or the value of a given amount of foreign currency, when converted to Australian dollars		
1.1.7 calculate the dividend paid on a portfolio of shares given the percentage dividend or dividend paid for each share, and compare share values by calculating a price-to-earnings ratio		

Use of spreadsheets

Specific Expectations	Lessons
1.1.8 use a spreadsheet to display examples of the above computations when multiple or repeated computations are required; for example, preparing a wage-sheet displaying the weekly earnings of workers in a fast food store where hours of employment and hourly rates of pay may differ, preparing a budget, or investigating the potential cost of owning and operating a car over a year	• Using a Spreadsheet to Calculate Income and Benefits • Using a Spreadsheet to Prepare a Budget

Topic 1.2: Algebra and matrices

Linear and non-linear expressions

Specific Expectations	Lessons
1.2.1 substitute numerical values into algebraic expressions, and evaluate (with the aid of technology where complicated numerical manipulation is required)	• Substitution and Evaluation • Using Formulas • Applying Algebra: Rugby Balls
1.2.2 determine the value of the subject of a formula, given the values of the other pronumerals in the formula (transposition not required)	
1.2.3 use a spreadsheet or an equivalent technology to construct a table of values from a formula, including tables for formulas with two variable quantities; for example, a table displaying the body mass index (BMI) of people of different weights and heights	

Matrices and matrix arithmetic

Specific Expectations	Lessons	
1.2.4 use matrices for storing and displaying information that can be presented in rows and columns; for example, databases, links in social or road networks 1.2.5 recognise different types of matrices (row, column, square, zero, identity) and determine their size 1.2.6 perform matrix addition, subtraction, multiplication by a scalar, and matrix multiplication, including determining the power of a matrix using technology with matrix arithmetic capabilities when appropriate 1.2.7 use matrices, including matrix products and powers of matrices, to model and solve problems; for example, costing or pricing problems, squaring a matrix to determine the number of ways pairs of people in a communication network can communicate with each other via a third person	• Using Matrices for Storing Information • Write a Matrix From a Table • Types of Matrices • Add and Subtract Matrices • State the Order of a Matrix • Matrix Multiplication • Power of Matrices • Find When a Matrix Expression is Defined	• Interpret a Matrix Product • Which Matrix Expression Gives a Sum or Average? • Using Matrices to Solve Problems • Question Bank: Algebra and MatricesQuestion Bank: Algebra and Matrices

Topic 1.3: Shape and measurement

Pythagoras' theorem

Specific Expectations	Lessons	
1.3.1 use Pythagoras' theorem to solve practical problems in two dimensions and for simple applications in three dimensions	• Parts of a Triangle and the Hypotenuse • Pythagoras' Theorem • Pythagoras' Theorem	• Pythagoras' Theorem in 3D • Pythagoras' Theorem in 3D • Building with Pythagoras

Mensuration

Specific Expectations	Lessons	
1.3.2 solve practical problems requiring the calculation of perimeters and areas of circles, sectors of circles, triangles, rectangles, parallelograms and composites	• Perimeter • Perimeters of Kites, Rhombuses, Trapeziums and Parallelograms • Circumference of Circles • Using the Circumference of Circles • Perimeters of Triangles, Rectangles, Trapeziums, Parallelograms & Composites • Area of Triangles, Rectangles, Trapezius, Parallelograms & Composites • Areas of Circles • Volume of Cones	• Volume of Right Cones • Finding the Height of Right Pyramids • Volume of Right Pyramids • Volume of Right Pyramids • Volume of Spheres • Volume of Composite Solids • Surface Area of Right Cones • Surface Area of Right Cones • Finding the Height of Right Pyramids • S. Area of Right Pyramids • Surface Area of Spheres • S Area of Composite Solids
1.3.3 calculate the volumes of standard three-dimensional objects, such as spheres, rectangular prisms, cylinders, cones, pyramids and composites in practical situations, for example, the volume of water contained in a swimming pool		
1.3.4 calculate the surface areas of standard three-dimensional objects, such as spheres, rectangular prisms, cylinders, cones, pyramids and composites in practical situations; for example, the surface area of a cylindrical food container		

Similar figures and scale factors

Specific Expectations	Lessons	
1.3.5 review the conditions for similarity of two-dimensional figures, including similar triangles	• Introduction to Similarity • Similarity Tests • Introduction to Scaling • Scaling on Cartesian Planes • Magnitude	• Magnitude as a Ratio • Using Scale Factors to Calculate Area • Using Scale Factors to Calculate Surface Area and Volume • Question Bank- Topic 2: Shape and Measurement • Question Bank: Shape and Measurement
1.3.6 use the scale factor for two similar figures to solve linear scaling problems		
1.3.7 obtain measurements from scale drawings, such as maps or building plans, to solve problems		
1.3.8 obtain a scale factor and use it to solve scaling problems involving the calculation of the areas of similar figures and surface areas and volumes of similar solids		

Unit 2

Topic 2.1: Univariate data analysis and the statistical investigation process

The statistical investigation process

Specific Expectations	Lessons
2.1.1 review the statistical investigation process; identifying a problem and posing a statistical question, collecting or obtaining data, analysing the data, interpreting and communicating the results	• PPDAC: The Statistical Enquiry Cycle

Making sense of data relating to a single statistical variable

<table>
<tr><th>Specific Expectations</th><th colspan="2">Lessons</th></tr>
<tr><td>2.1.2 classify a categorical variable as ordinal, such as income level (high, medium, low) or nominal, such as place of birth (Australia, overseas) and use tables and bar charts to organise and display data</td><td rowspan="8">Types of Data
Types of Data
Column (Bar) Graphs
Dot Plots, Stem and Leaf Plots and Histograms
Dot Plots, Stem and Leaf Plots and Histograms
Shape and Mode
Symmetry and Skew in Data
Clusters and Outliers</td><td rowspan="8">Measures of Centre and Spread
Calculating Standard Deviation
Calculating Standard Deviation Using Technology
Calculating Standard Deviation Using a Scientific Calculator
Calculating Standard Deviation
Using the Standard Deviation to Compare Data Sets
Investigating the Standard Deviation
Mean and Standard Deviation</td></tr>
<tr><td>2.1.3 classify a numerical variable as discrete, such as the number of rooms in a house, or continuous, such as the temperature in degrees Celsius</td></tr>
<tr><td>2.1.4 with the aid of an appropriate graphical display (chosen from dot plot, stem plot, bar chart or histogram), describe the distribution of a numerical data set in terms of modality (uni or multimodal), shape (symmetric versus positively or negatively skewed), location and spread and outliers, and interpret this information in the context of the data</td></tr>
<tr><td>2.1.5 determine the mean and standard deviation of a data set using technology and use these statistics as measures of location and spread of a data distribution, being aware of their limitations</td></tr>
<tr><td>2.1.6 use the number of deviations from the mean (standard scores) to describe deviations from the mean in normally distributed data sets</td></tr>
<tr><td>2.1.7 calculate quantiles for normally distributed data with known mean and standard deviation in practical situations</td></tr>
<tr><td>2.1.8 use the 68%, 95%, 99.7% rule for data one, two and three standard deviations from the mean in practical situations</td></tr>
<tr><td>2.1.9 calculate probabilities for normal distributions with known mean μ and standard deviation σ in practical situations</td></tr>
</table>

Comparing data for a numerical variable across two or more groups

Specific Expectations	Lessons	
2.1.10 construct and use parallel box plots (including the use of the ‘Q1 – 1.5 x IQR’ and ‘Q3 + 1.5 x IQR’ criteria for identifying possible outliers) to compare groups in terms of location (median), spread (IQR and range) and outliers, and interpret and communicate the differences observed in the context of the data	• Quartiles and the Interquartile Range • Comparing Box and Whisker Plots • Clusters and Outliers • Comparing Data Sets • Reporting on Comparisons • Comparing Data Sets • Comparing Data Sets • Comparing the Measures of Spread	• Problem: Forming a Comparative Investigative Question • Plan: Sample Size • Data: Data Cleaning • Analysis: Measures of Centre • Analysis: Measures of Spread • Analysis: Making an Inference Using Shift • Analysis: Making an Inference Using DBM:OVS • Conclusion: Writing the Conclusion • Question Bank: Univariate Data Analysis • Question Bank: Univariate Data Analysis
2.1.11 compare groups on a single numerical variable using medians, means, IQRs, ranges or standard deviations, and as appropriate; interpret the differences observed in the context of the data and report the findings in a systematic and concise manner		
2.1.12 implement the statistical investigation process to answer questions that involve comparing the data for a numerical variable across two or more groups; for example, are Year 11 students the fittest in the school?		

Topic 2.2: Applications of trigonometry

Application of Trigonometry

<table>
<tr><th>Specific Expectations</th><th>Lessons</th><th></th></tr>
<tr><td>2.2.1 use trigonometric ratios to determine the length of an unknown side, or the size of an unknown angle in a right-angled triangle</td><td rowspan="4">

- Trigonometric Ratios
- Introduction to Trigonometry
- Trigonometric Ratios
- Finding Side Lengths
- Finding Angles
- 3D Problems Using Right-Angled Triangles
- Trigonometry in 3D

- Area of Triangles
- Area of a Triangle: ½ ab sin C
- Heron's Formula

- Trigonometric Rules
- The Sine Rule
- Angles Using the Sine Rule
- The Cosine Rule
- Angles Using the Cosine Rule
- Review Lesson
- Review Lesson

</td><td rowspan="4">

- Bearings
- Bearings with Right-Angled Triangles
- Bearings with Right-Angled Triangles
- Angles of Elevation and Depression

- Practical Applications
- Using Trigonometric Functions in Real World Applications
- Using Inverse Trigonometric Functions in Real World Applications
- Airplane Flight Paths
- Pirates' Treasure
- Forestry Subdivision
- Balloons Over Waikato

- Question Bank: Applications of Trigonometry
- Question Bank: Applications of Trigonometry

</td></tr>
<tr><td>2.2.2 determine the area of a triangle, given two sides and an included angle by using the rule area=12 absinC, or given three sides by using Heron's rule, and solve related practical problems</td></tr>
<tr><td>2.2.3 solve problems involving non-right-angled triangles using the sine rule (acute triangles only when determining the size of an angle) and the cosine rule</td></tr>
<tr><td>2.2.4 solve practical problems involving right-angled and non-right-angled triangles, including problems involving angles of elevation and depression and the use of bearings in navigation</td></tr>
</table>

Topic 2.3: Linear equations and their graphs

Linear equations

Specific Expectations	Lessons	
2.3.1 identify and solve linear equations (with the aid of technology where complicated manipulations are required)	• Solving Linear Equations • Solving Linear Equations • Solving Linear Equations with Fractions • How to Model Situations	
2.3.2 develop a linear formula from a word description and solve the resulting equation		

Straight-line graphs and their applications

Specific Expectations	Lessons	
2.3.3 construct straight-line graphs both with and without the aid of technology	• Plotting Linear Equations Using Tables • Drawing the Line from an Equation • Drawing the Line from an Equation • Slope and Intercept from a Graph	• Finding the Equation Using the Slope and Intercept • Modelling Situations: The Leaky Bike Tyre • Modelling Situations: Global Warming • Modelling Situations: Gym Membership • Modelling Situations: The Road Trip
2.3.4 determine the slope and intercepts of a straight-line graph from both its equation and its plot		
2.3.5 construct and analyse a straight-line graph to model a given linear relationship; for example, modelling the cost of filling a fuel tank of a car against the number of litres of petrol required.		
2.3.6 interpret, in context, the slope and intercept of a straight-line graph used to model and analyse a practical situation		

Simultaneous linear equations and their applications

Specific Expectations	Lessons	
2.3.7 solve a pair of simultaneous linear equations graphically or algebraically, using technology when appropriate	• Solving Simultaneous Equations Using Graphs • Solving Simultaneous Equations Using Substitution • Solving Simultaneous Equations Using Elimination	• Applications of Simultaneous Equations • Solving Simultaneous Linear Equations using Technology
2.3.8 solve practical problems that involve determining the point of intersection of two straight-line graphs; for example, determining the break-even point where cost and revenue are represented by linear equations		

Piece-wise linear graphs and step graphs

Specific Expectations	Lessons	
2.3.9 sketch piece-wise linear graphs and step graphs, using technology when appropriate 2.3.10 interpret piece-wise linear and step graphs used to model practical situations; for example, the tax paid as income increases, the change in the level of water in a tank over time when water is drawn off at different intervals and for different periods of time, the charging scheme for sending parcels of different weights through the post	• Step Functions • Piecewise Linear Graphs • Finding Piecewise Equations • Luke's Loan • Non-Linear Piecewise Functions • Australian Tax Rates and Brackets	• Question Bank- Linear Equations and their Graphs • Question Bank: Linear Equations and their Graphs

Unit 3

Topic 3.1: Bivariate data analysis

The statistical investigation process

Specific Expectations	Lessons
3.1.1 review the statistical investigation process: identify a problem; pose a statistical question; collect or obtain data; analyse data; interpret and communicate results	

Identifying and describing associations between two categorical variables

Specific Expectations	Lessons	
3.1.2 construct two-way frequency tables and determine the associated row and column sums and percentages	• Introduction to Bivariate Data • Introduction to Spreadsheets • Two-way Frequency Tables • Constructing Two-way Frequency Tables • Using Two-way Frequency Tables to Identify Associations	• Plotting Using a Calculator • Plotting Using a Spreadsheet • Analysing Trend by Eye • Correlation Coefficient • Calculating the Correlation Coefficient using a Graphic Calculator • Calculating the Correlation Coefficient using a Spreadsheet
3.1.3 use an appropriately percentaged two-way frequency table to identify patterns that suggest the presence of an association		
3.1.4 describe an association in terms of differences observed in percentages across categories in a systematic and concise manner, and interpret this in the context of the data		
3.1.5 construct a scatterplot to identify patterns in the data suggesting the presence of an association		
3.1.6 describe an association between two numerical variables in terms of direction (positive/negative), form (linear/non-linear) and strength (strong/moderate/weak)		
3.1.7 calculate, using technology, and interpret the correlation coefficient (r) to quantify the strength of a linear association		

Fitting a linear model to numerical data

Specific Expectations	Lessons	
3.1.8 identify the response variable and the explanatory variable for primary and secondary data	• Bivariate Variables • Lines of Best Fit by Eye • Least Squares Fitting using a Calculator • Least Squares Fitting using a Spreadsheet • Residuals	• Least Squares Fitting using a Graphic Calculator • Coefficient of Determination • Making Predictions by Eye • Making Predictions Using the Equation
3.1.9 use a scatterplot to identify the nature of the relationship between variables		
3.1.10 model a linear relationship by fitting a least-squares line to the data		
3.1.11 use a residual plot to assess the appropriateness of fitting a linear model to the data		
3.1.12 interpret the intercept and slope of the fitted line		
3.1.13 use the coefficient of determination to assess the strength of a linear association in terms of the explained variation		
3.1.14 use the equation of a fitted line to make predictions		
3.1.15 distinguish between interpolation and extrapolation when using the fitted line to make predictions, recognising the potential dangers of extrapolation		
3.1.16 write up the results of the above analysis in a systematic and concise manner		

Association and causation

Specific Expectations	Lessons	
3.1.17 recognise that an observed association between two variables does not necessarily mean that there is a causal relationship between them	• Correlation vs. Causation • Solve Practical Problems Involving Associations	• Question Bank: Bivariate Data Analysis • Question Bank: Bivariate Data Analysis • Question Bank - Topic 3.1 Bivariate Data Analysis
3.1.18 recognise possible non-causal explanations for an association, including coincidence and confounding due to a common response to another variable, and communicate these explanations in a systematic and concise manner		

Topic 3.2: Growth and decay in sequences

The arithmetic sequence and the geometric sequence

Specific Expectations	Lessons	
3.2.1 use recursion to generate an arithmetic sequence	• Recursive Arithmetic Sequences • Recursive Geometric Sequences • Introduction to Arithmetic Sequences • Finding an Arithmetic Term • Finding a Term Number for an Arithmetic Sequence • Geometric Sequences • Graphing Arithmetic Sequences • Graphing Geometric Sequences • Recursive Sequences • Sequences and Series Using Technology	• Using Arithmetic Sequences to Model & Analyse Practical Situations • Using Geometric Sequences to Model & Analyse Practical Problems • Problem Solving: Cold Case • Student Accommodation Investigation • Fibonacci Sequence • Question Bank: Growth and Decay in Sequences • Question Bank: Growth and Decay in Sequences • Question Bank - Topic 3.2 Growth and Decay in Sequences
3.2.2 display the terms of an arithmetic sequence in both tabular and graphical form and demonstrate that arithmetic sequences can be used to model linear growth and decay in discrete situations		
3.2.3 deduce a rule for the nth term of a particular arithmetic sequence from the pattern of the terms in an arithmetic sequence, and use this rule to make predictions		
3.2.4 use arithmetic sequences to model and analyse practical situations involving linear growth or decay		
3.2.5 use recursion to generate a geometric sequence		
3.2.6 display the terms of a geometric sequence in both tabular and graphical form and demonstrate that geometric sequences can be used to model exponential growth and decay in discrete situations		
3.2.7 deduce a rule for the nth term of a particular geometric sequence from the pattern of the terms in the sequence, and use this rule to make predictions		
3.2.8 use geometric sequences to model and analyse (numerically, or graphically only) practical problems involving geometric growth and decay		

Sequences generated by first-order linear recurrence relations

Specific Expectations	Lessons
3.2.9 use a general first-order linear recurrence relation to generate the terms of a sequence and to display it in both tabular and graphical form	
3.2.10 generate a sequence defined by a first-order linear recurrence relation that gives long term increasing, decreasing or steady-state solutions	
3.2.11 use first-order linear recurrence relations to model and analyse (numerically or graphically only) practical problems	

Topic 3.3: Graphs and networks

The definition of a graph and associated terminology

Specific Expectations	Lessons
3.3.1 demonstrate the meanings of, and use, the terms: graph, edge, vertex, loop, degree of a vertex, subgraph, simple graph, complete graph, bipartite graph, directed graph (digraph), arc, weighted graph, and network	• Understanding Graph Terminology and Representing Practical Situations Using Networks • Understanding Graph Terminology and Representing Practical Situations Using Networks • Constructing Networks • Equivalent Networks • Constructing an Adjacency Matrix
3.3.2 identify practical situations that can be represented by a network, and construct such networks	
3.3.3 construct an adjacency matrix from a given graph or digraph and use the matrix to form multi-stage matrices to solve associated problems	

Planar graphs

Specific Expectations	Lessons	
3.3.4 demonstrate the meanings of, and use, the terms: planar graph and face	• Understanding Planar Graphs and Applying Euler's Formula	
3.3.5 apply Euler's formula, v+f-e=2 to solve problems relating to planar graphs		

Paths and cycles

Specific Expectations	Lessons	
3.3.6 demonstrate the meanings of, and use, the terms: walk, trail, path, closed walk, closed trail, cycle, connected graph, and bridge	• Eulerian Networks • Determining the Shortest Path by Trial and Error • The Shortest Path • Traversable Networks • Hamiltonian Networks • Hamiltonian Networks • Glossary: Graphs and Networks	• Question Bank: Graphs and Networks • Question Bank: Graphs and Networks • Question Bank - Topic 3.3 Graphs and Networks
3.3.7 investigate and solve practical problems to determine the shortest path between two vertices in a weighted graph (by trial-and-error methods only)		
3.3.8 demonstrate the meanings of, and use, the terms: Eulerian graph, Eulerian trail, semi-Eulerian graph, semi-Eulerian trail and the conditions for their existence, and use these concepts to investigate and solve practical problems		
3.3.9 demonstrate the meanings of, and use, the terms: Hamiltonian graph and semi-Hamiltonian graph, and use these concepts to investigate and solve practical problems		

Unit 4

Topic 4.1: Time series analysis

Describing and interpreting patterns in time series data

Specific Expectations	Lessons
4.1.1. construct time series plots	• Introduction to Time Series • Analysing Time Series • Describing and interpreting Time Series
4.1.2 describe time series plots by identifying features such as trend (long term direction), seasonality (systematic, calendar-related movements), and irregular fluctuations (unsystematic, short term fluctuations), and recognise when there are outliers	

Analysing time series data

Specific Expectations	Lessons
4.1.3 smooth time series data by using a simple moving average, including the use of spreadsheets to implement this process	• Smoothing Time Series Data by Using a Simple Moving Average • Calculating Seasonal Indices • Deseasonalising a time series by using a seasonal index • Fitting a Least-squares Line to Model Long-term Trends in Time Series Data • Solving Practical Problems that Involve the Analysis of Time Series Data • Glossary: Time Series Data Analysis • Question Bank: Time Series Analysis • Question Bank: Time Series Analysis • Question Bank - Topic 4.1 Time Series Analysis
4.1.4 calculate seasonal indices by using the average percentage method	
4.1.5 deseasonalise a time series by using a seasonal index, including the use of spreadsheets to implement this process	
4.1.6 fit a least-squares line to model long-term trends in time series data	
4.1.7 predict from regression lines, making seasonal adjustments for periodic data	

The data investigation process

Specific Expectations	Lessons
4.1.8 implement the statistical investigation process to answer questions that involve the analysis of time series data	

Topic 4.2: Loans, investments and annuities

Compound interest loans and investments

Specific Expectations	Lessons
4.2.1 use a recurrence relation to model a compound interest loan or investment and investigate (numerically or graphically) the effect of the interest rate and the number of compounding periods on the future value of the loan or investment	• Using a Recurrence Relation to Model a Compound Interest Loan or Investment • Effective Rate of Interest • Term Deposits • Depreciation • Solving Problems Involving Compound Interest Loans and Investments
4.2.2 calculate the effective annual rate of interest and use the results to compare investment returns and cost of loans when interest is paid or charged daily, monthly, quarterly or six-monthly	
4.2.3 with the aid of a calculator or computer-based financial software, solve problems involving compound interest loans, investments and depreciating assets	

Reducing balance loans (compound interest loans with periodic repayments)

Specific Expectations	Lessons	
4.2.4 use a recurrence relation to model a reducing balance loan and investigate (numerically or graphically) the effect of the interest rate and repayment amount on the time taken to repay the loan	• Reducing Balance Loans	
4.2.5 with the aid of a financial calculator or computer-based financial software, solve problems involving reducing balance loans		

Annuities and perpetuities (compound interest investments with periodic payments made from the investment)

Specific Expectations	Lessons	
4.2.6 use a recurrence relation to model an annuity, and investigate (numerically or graphically) the effect of the amount invested, the interest rate, and the payment amount on the duration of the annuity	• Modelling Annuities & Loans Using Spreadsheets • Solving Problems Involving Annuities • Glossary: Loans, Investments and Annuities	• Question Bank: Loans, Investments and Annuities • Question Bank: Loans, Investments and Annuities • Question Bank - Topic 4.2 Loans, Investments. . .
4.2.7 with the aid of a financial calculator or computer-based financial software, solve problems involving annuities (including perpetuities as a special case)		

Topic 4.3: Networks and decision mathematics

Trees and minimum connector problems

Specific Expectations	Lessons
4.3.1 identify practical examples that can be represented by trees and spanning trees	• Minimum Spanning Trees
4.3.2 identify a minimum spanning tree in a weighted connected graph, either by inspection or by using Prim's algorithm	
4.3.3 use minimal spanning trees to solve minimal connector problems	

Project planning and scheduling using critical path analysis (CPA)

Specific Expectations	Lessons	
4.3.4 construct a network to represent the durations and interdependencies of activities that must be completed during the project	• Constructing Network Diagrams • Forward and Backward Scanning • Using the Critical Path to Determine the Minimum Time for a Project to be Completed	• Calculating Float Times for Non-critical Activities • Solving Problems Involving Critical Path Analysis
4.3.5 use forward and backward scanning to determine the earliest starting time (EST) and latest starting times (LST) for each activity in the project		
4.3.6 use ESTs and LSTs to locate the critical path(s) for the project		
4.3.7 use the critical path to determine the minimum time for a project to be completed		
4.3.8 calculate float times for non-critical activities		

Flow networks

Specific Expectations	Lessons
4.3.9 solve small-scale network flow problems, including the use of the 'maximum flow-minimum cut' theorem	• Introduction to Flow Networks • Flow Capacity of Networks • Maximum-Flow Minimum Cut Theorem

Assignment problems

Specific Expectations	Lessons	
4.3.10 use a bipartite graph and/or its tabular or matrix form to represent an assignment/allocation problem	• Using Bipartite Graphs for Assignment/Allocation Problems • Determining Optimum Assignments using the Hungarian Algorithm	• Question Bank: Networks and Decision Mathematics • Question Bank: Networks and Decision Mathematics • Question Bank - Topic 4.3 Networks and Decision Mathematics
4.3.11 determine the optimum assignment(s), by inspection for small-scale problems, or by use of the Hungarian algorithm for larger problems		