



Units 3 and 4 Further Maths: Exam 1

Practice Exam Solutions

Stop!

Don't look at these solutions until you have attempted the exam.

Any questions?

Check the Engage website for updated solutions, then email practiceexams@ee.org.au.

Section A – Core

Data Analysis

Question 1

The correct answer is C

This bar is the highest, therefore the temperature was in that range for the most number of days.

Question 2

The correct answer is C

$$\frac{4}{31} = 0.129$$

$$0.129 \times 100 = 12.9\% = 13\%$$

Question 3

The correct answer is B

$$164.5 \times 24 = 3948cm$$

Question 4

The correct answer is A

Weight is numerical and date of birth is categorical.

Question 5

The correct answer is C

Given that the question involves time, a time series is most appropriate.

Question 6

The correct answer is A

The coefficient of determination is r^2 , and Pearson's product-moment correlation coefficient is r .

$$\text{Therefore, } \sqrt{0.61} = 0.78$$

Question 7

The correct answer is D

From the box plot describing the Melbourne data, we can see that Q1 is 3.2, and Q3 is 4. 50% of the values lie between the 1st and 3rd quartile, therefore 50% of the data lies between these two values.

Question 8

The correct answer is B

The mean is affected by outliers. As the value 5.3 is beyond the maximum fence ($4 + 1.5 \times 0.8 = 5.2$), 5.3 will be an outlier, and it will affect the mean.

Question 9

The correct answer is A

It's important to understand that the equation is in the form $y = a + bx$

The independent variable, or x , is temperature. The dependent variable, or y , is the number of ice creams sold. From the graph, the y intercept will not be positive. Therefore, only option A fits.

Question 10

The correct answer is C

Jane's English score is approximately 1.5 standard deviations above the class mean. Therefore, she requires a score of approximately 1.5 standard deviations above the class mean for Maths.

$64 + (1.5 \times 7) = 74.5$, which is closest to 75.

Question 11

The correct answer is D

$765000 \times 0.367 = 280755$, which is closest to 281000.

Question 12

The correct answer is D

Option D is the only option that is both correct and supports the contention.

Question 13

The correct answer is D

All other options can be negative.

Question 14

The correct answer is C

Calculate the seasonal average $\frac{53+42+28+47}{4} = 42.5$

Calculate seasonal index for Q4 $\frac{47}{42.5} = 1.105 = 1.11$

Question 15

The correct answer is A

$\text{deseasonalised value} = \frac{\text{actual value}}{\text{seasonal index}} = \frac{53}{1.25} = 42.4$

Question 16

The correct answer is D

$\text{seasonal index} = \frac{\text{values for season}}{\text{seasonal average}}$

$\text{seasonal index for Q3 2015} = \frac{28}{42.5} = 0.66$

$\text{deseasonalised value} = \frac{\text{actual value}}{\text{seasonal index}}$

Using the CAS calculator, $\text{solve}(52 = \frac{x}{0.66}, x) = 34$

*Recursion and Financial Modelling***Question 17**

The correct answer is C

Find the GST with $\frac{125.40}{11} = 11.4$

$$125.4 - 11.4 = 114$$

$$\frac{114}{2} = \$57$$

Question 18

The correct answer is E

$$I = \frac{34000 \times 4 \times 5}{100} = 6800$$

$$34000 + 6800 = \$40800$$

Question 19

The correct answer is B

$$\frac{4750 \times 0.75}{100} = 35.63$$

$$24 \times 2.95 + 35.63 = \$106.43$$

$$\frac{106.43}{4750} \times 100 = 2.25\%$$

Question 20

The correct answer is C

$$52 \times 100 = 5200$$

$$5200 - 4750 = 450$$

$$r = \frac{I \times 100}{PT} = \frac{450 \times 100}{4750 \times 2} = 4.7\%$$

Question 21

The correct answer is C

$$P = \frac{I \times 100}{rT} = \frac{15000 \times 100}{4.8 \times 1} = \$312500$$

Question 22

The correct answer is E

This question can be solved using both the Interest rate conversion function on the CAS or by using the effective interest formula as follows:

$$r_{\text{effective}} = \left(1 + \frac{r}{n}\right)^n - 1,$$

where r is the nominal rate and n is the number compounding periods per year.

$$\text{Here } r_{\text{effective}} = 9.5\%$$

$$n = 12 \text{ (monthly payment)}$$

$$r_{\text{effective}} = 9.5\% = \left(1 + \frac{r}{12}\right)^{12} - 1$$

$$\text{Hence, } r = 0.091 = 9.1\%$$

Question 23

The correct answer is D

$$I = P\left(1 + \frac{r}{1200}\right)^n - P\left(1 + \frac{r}{1200}\right)^{n-1}$$

where n is the number compounding periods in the period described

and $n - 1$ is the period described minus one set of n

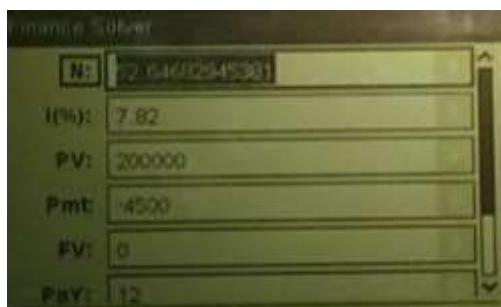
As the interest compounds monthly, there are 12 periods per year. Therefore, $n = 60$ and $n-1 = 48$.

Question 24

The correct answer is D

Monthly repayments for 5 years = 60 payments

As shown on the CAS calculator, if payments are increased to \$4500 per month, it will be paid off in 53 payments, therefore within 5 years.



Section B – Modules

Module 1 – Matrices

Question 1

The correct answer is E

$$\begin{bmatrix} 1 & 3 & 3 \\ 3 & 4 & 2 \\ 3 & 5 & 4 \end{bmatrix} \begin{bmatrix} 2 \\ 1 \\ 6 \end{bmatrix} = \begin{bmatrix} 23 \\ 22 \\ 35 \end{bmatrix}$$

$$\begin{bmatrix} 23 \\ 22 \\ 35 \end{bmatrix} - 2 \begin{bmatrix} 3 \\ 4 \\ 8 \end{bmatrix} = E$$

Question 2

The correct answer is D

Matrix B is a 3x4 matrix. Matrix A is a 4x2 matrix. As the number of columns of matrix B is the same as the number of rows in matrix A, they are multipliable to give C. $(3 \times 4) \times (4 \times 2) = (3 \times 2)$ matrix. Therefore, matrix C has 3 rows and two columns.

Question 3

The correct answer is B

$$\text{determinant} = ad - bc \text{ where } \begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

$$3 \times 6 - 2 \times 8 = 18 - 16 = 2$$

Question 4

The correct answer is D

$$\begin{bmatrix} 1 & y \\ 1 & 4 \end{bmatrix} \times \begin{bmatrix} a \\ b \end{bmatrix} = \begin{bmatrix} 4 \\ 6 \end{bmatrix}$$

If the equations do not have a solution, determinant = 0

$$\text{det} = 4 - y = 0. \text{ Hence, } y = 4$$

Question 5

The correct answer is D

$$\begin{bmatrix} 0.3 & 0.1 & 0.3 \\ 0.5 & 0.7 & 0.3 \\ 0.2 & 0.2 & 0.4 \end{bmatrix}^2 \begin{bmatrix} 20 \\ 17 \\ 31 \end{bmatrix} = \begin{bmatrix} 14 \\ 36 \\ 18 \end{bmatrix}$$

Therefore, 36 bananas will be required.

Question 6

The correct answer is A

$$\begin{bmatrix} 0.3 & 0.1 & 0.3 \\ 0.5 & 0.7 & 0.3 \\ 0.2 & 0.2 & 0.4 \end{bmatrix}^{20} \begin{bmatrix} 20 \\ 17 \\ 31 \end{bmatrix} = \begin{bmatrix} 12.75 \\ 38.25 \\ 17 \end{bmatrix}$$

$$\begin{bmatrix} 0.3 & 0.1 & 0.3 \\ 0.5 & 0.7 & 0.3 \\ 0.2 & 0.2 & 0.4 \end{bmatrix}^{21} \begin{bmatrix} 20 \\ 17 \\ 31 \end{bmatrix} = \begin{bmatrix} 12.75 \\ 38.25 \\ 17 \end{bmatrix}$$

Therefore, 13 apples, 38 bananas and 17 oranges will be required long term.

Question 7

The correct answer is C

$$\begin{bmatrix} 1 & 1 & 3 \\ 2 & 3 & 1 \\ 3 & 2 & 3 \end{bmatrix} \times \begin{bmatrix} c \\ t \\ d \end{bmatrix} = \begin{bmatrix} 12 \\ 13 \\ 19.5 \end{bmatrix}$$

$$\begin{bmatrix} c \\ t \\ d \end{bmatrix} = \begin{bmatrix} 1 & 1 & 3 \\ 2 & 3 & 1 \\ 3 & 2 & 3 \end{bmatrix}^{-1} \times \begin{bmatrix} 12 \\ 13 \\ 19.5 \end{bmatrix}$$

$$\begin{bmatrix} c \\ t \\ d \end{bmatrix} = \begin{bmatrix} 3 \\ 1.5 \\ 2.5 \end{bmatrix}$$

$$\begin{bmatrix} 2 & 3 & 4 \end{bmatrix} \times \begin{bmatrix} c \\ t \\ d \end{bmatrix} = \begin{bmatrix} 6 \\ 4.5 \\ 10 \end{bmatrix}$$

Question 8

The correct answer is B

Each row represents a student. Each column represents a subject.

	L	M	P	S	J	V
A	1	1	1	0	1	0
B	0	1	1	0	1	0
C	0	0	0	1	0	1
D	1	1	0	1	1	1
E	0	0	0	0	1	0
	1	0	0	1	0	1

Module 2 – Networks and Decision Mathematics

Question 1

The correct answer is E

A complete network with n vertices has $\frac{n(n-1)}{2}$ edges

$$\frac{6(6-1)}{2} = 15$$

Question 2

The correct answer is C

An Euler Circuit uses every edge of the graph once. It starts and ends at the same vertex. For this to occur, an extra edge must be added between A and D.

Question 3

The correct answer is D

The critical path is the longest amount of time taken to complete a project. In this case, the longest accurate amount of time is 20 hours, on path B-C-F-I.

Question 4

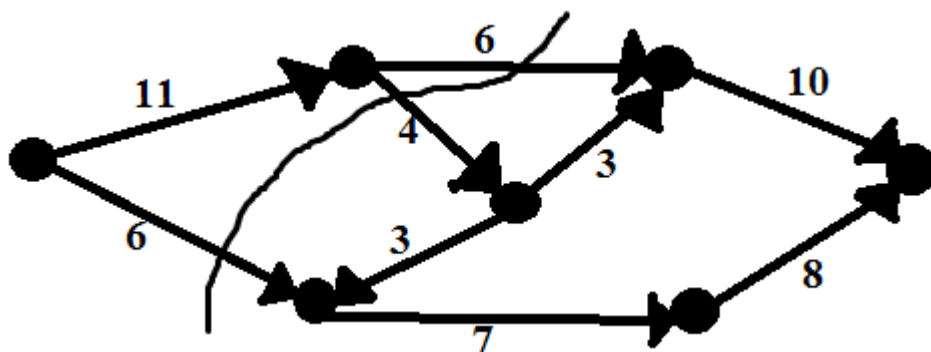
The correct answer is B

As F is on the critical path, it should be crashed by 2 hours to reduce the time from 20 hours to 18 hours. However, a new critical path emerges at 19 hours (A-D-H-I). Therefore, activity H must also be crashed by 1 hour to ensure the completion time is 18 hours.

Question 5

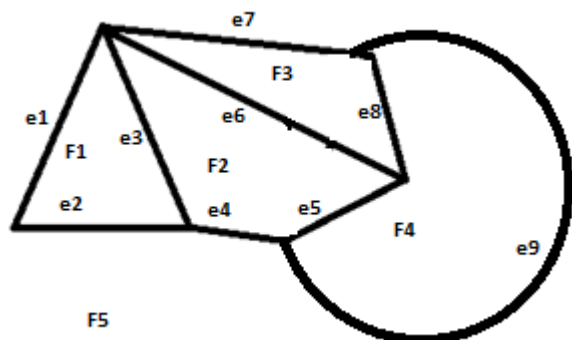
The correct answer is E

The minimum cut gives the maximum flow through a network. It is the cut that separates the source and the sink with the lowest value.



Question 6

The correct answer is A



Eulers formula $\rightarrow V + F = e + 2$

$V = 9 + 2 - 5 = 6$

Question 7

The correct answer is C

The arrows point from the winner to the loser of a game. Statement A is false as Anna lost to everyone except Billie. Statement B is false as Dylan only have 1 arrow pointing towards him, so he only lost 1 game. Statement D is false as the arrow points from Caitlin to Billie, so Caitlin beat Billie. Statement E is false as Billie lost 3 matches.

Question 8

The correct answer is D

One-step

0	1	0	0	0	1
0	0	0	0	1	1
1	1	0	0	1	3
1	1	1	0	0	3
1	0	0	1	0	2

Two-step

0	0	0	0	1	1
1	0	0	1	0	2
1	1	0	1	1	4
1	2	0	0	2	5
1	2	1	0	0	4

Three-step

1	0	0	1	0	2
1	2	1	0	0	4
2	2	1	1	1	7
2	1	0	2	2	7
1	2	0	0	3	6

D is correct because at 2 steps, Dylan has a dominance over Caitlin (5 over 4)

*Module 3 – Geometry and Measurement***Question 1**

The correct answer is D

Using the cosine rule, $T = \cos\left(\frac{\text{adjacent}}{\text{hypoteneuse}}\right)$

$$T = \cos\left(\frac{1.4}{2.3}\right) = 53^\circ$$

Question 2

The correct answer is A

$$\frac{c}{\sin(c)} = \frac{a}{\sin(a)}$$

$$\frac{c}{\sin(130)} = \frac{7}{\sin(30)}$$

$$c = \frac{7 \times \sin(13)}{\sin(30)} = 10.72 = 11\text{cm}$$

Question 3

The correct answer is B

The volume can be split into 2 parts – the rectangular box and the triangular prism parts.

For the rectangular part:

$$V = l \times w \times h = 12 \times 5 \times 7 = 420$$

For the triangular prism:

$$V = SA \times l = 0.5 \times (7.5-5) \times 7 \times 12 = 105.$$

They combine to give 525 meters cubed.

Question 4

The correct answer is C

$$\text{volume} = l \times w \times h$$

$$30 = 3 \times 2 \times h$$

$$h = \frac{30}{6} = 5$$

$$\text{surface area} = 2 \times 3 + 2(3 \times 5) + 2(2 \times 5) = 56\text{m}^2$$

Question 5

The correct answer is D

According to similar triangles, we have:

$$\frac{DE}{AC} = \frac{BE}{BC}$$

$$\text{Hence, } \frac{DE}{16} = \frac{18}{18+6}$$

$$\therefore DE = 16 \times \frac{18}{18+6} = 12 \text{ .cm}$$

Question 6

The correct answer is B

$$v = \pi r^2 \frac{h}{3}$$

$$v = \pi 2^2 \frac{4}{3} = 16.76$$

Question 7

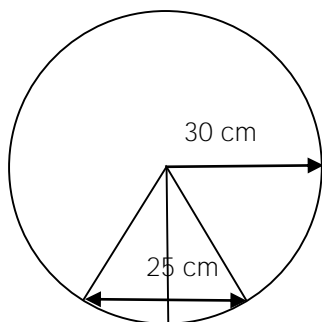
The correct answer is C

$$\sin(35.65) = \frac{x}{200}$$

$$200 \times \sin(35.65) = x = 116.6 = 117$$

Question 8

The correct answer is B



$$\begin{aligned} \text{width} &= \text{radius} - \text{height of the isosceles} \\ &= 30 - \sqrt{30^2 - \left(\frac{25}{2}\right)^2} \text{ (pythagorean theorem)} = 2.73 \text{ cm} \end{aligned}$$

Module 4 – Graphs and Relations

Question 1

The correct answer is A

The gradient of the graph is the steepest between 0-2 hours.

Question 2

The correct answer is E

The graph shows that between 2 hours and 11 hours, the wind speed is between 15-25 knots. Therefore, it is safe for 11-2 hours = 9 hours

Question 3

The correct answer is D

$$3 \text{ AFL games} + 2 \text{ movies} = 550 \text{ minutes} \rightarrow 3x + 2y = 550$$

$$2 \text{ AFL games} + 4 \text{ movies} = 620 \text{ minutes} \rightarrow 2x + 4y = 620$$

Question 4

The correct answer is C

Using the solve function on the calculator

$$\text{solve}(3x + 2y = 550 \text{ and } 2x + 4y = 620, x, y)$$

Question 5

The correct answer is B

Choose 2 points on the graph e.g. (-2, -12) and (2, 12)

Using the solve function on the calculator

$$\text{solve}(-12 = k(-2^2), k)$$

Question 6

The correct answer is E

$$45 \text{ minutes} = 0.75 \text{ hours}$$

$$75 \text{ minutes} = 1.25 \text{ hours}$$

0.75 x number of basketball sessions + 1.25 x number of cross country running sessions is equal to or less than 12 hours

$$0.75x + 1.25y \leq 12$$

Question 7

The correct answer is E

The inequation $0.75x + 1.25y \leq 12$ must be solved in order to find the x and y intercepts. The fact that Jess prefers at least 4 basketball training sessions must be plotted on the graph as well.

Question 8

The correct answer is D

Find the important information in the question

7 cakes which cost \$85 to make per cake

$$7 \times 85 = \text{total cost of cakes} = \$595$$

3 workers who will work for 5 hours and are paid \$25/hour

$$3 \times 5 \times 25 = \text{total cost of workers} = \$375$$

Add the total cost of the cakes and workers together = \$970

Divide the total cost of everything by the number of cakes

$$\frac{\$970}{7 \text{ cakes}} = \$138.57$$

Therefore, to break even (i.e. make the money expended back) he must charge \$138.57 per cake.