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Further Mathematics

2008

Trial Examination 1

Core – Data analysis
Module 1 – Number patterns
Module 5 – Networks and decision mathematics
Module 6 – Matrices

SECTION A Instructions

Answer **all** questions
A correct answer scores 1, an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if **more than one** answer is completed for any question.

Core – Data analysis

The following information relates to Questions 1 and 2

The weights (nearest kilogram) of 25 year 12 students are shown in the stemplot below.

5	9
6	3 3 3 3 4
6	7 8 9
7	0 0 1 1 1 2 4
7	6 6 7 8 9
8	2 3 4
8	
9	0

Question 1
The percentage of students in the group with weights greater than the mode is

A. 96

B. 88

C. 80

D. 76

E. 72

Question 2
The shape of the set of data in the stemplot is best described as

A. approximately symmetric with an outlier.

B. approximately symmetric with no outliers.

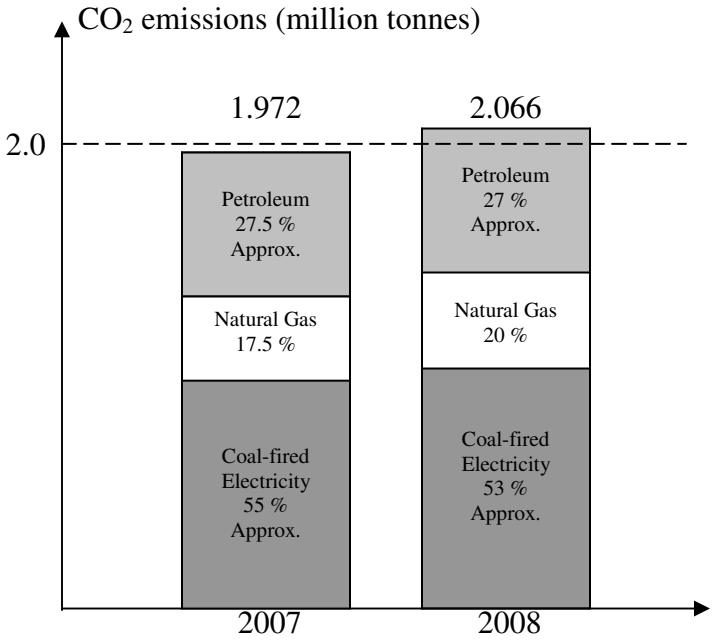
C. positively skewed with no outliers.

D. negatively skewed with an outlier.

E. symmetric about the mean.

The following information relates to Questions 3 and 4

The following graph shows Victoria's emissions of greenhouse gas (carbon dioxide CO_2 in million tonnes) from coal-fired electricity, natural gas and petroleum in the 21st week in 2007 and 2008.



Data from
www.theclimategroup.org/indicator

Question 3
The change in Victoria's **total emissions** of greenhouse gas from the three sources in the 21st week in 2008 comparing with that in the same period in 2007 is

A. a decrease of 4.8 % approximately

B. an increase of 4.8 % approximately

C. a decrease of 4.5 % approximately

D. an increase of 4.5 % approximately

E. an increase of 4.5 % per year approximately

Question 4
The change in Victoria's emissions of greenhouse gas **from coal-fired electricity** in the 21st week in 2008 comparing with that in the same period in 2007 is

A. a decrease of 2 % approximately

B. an increase of 2 % approximately

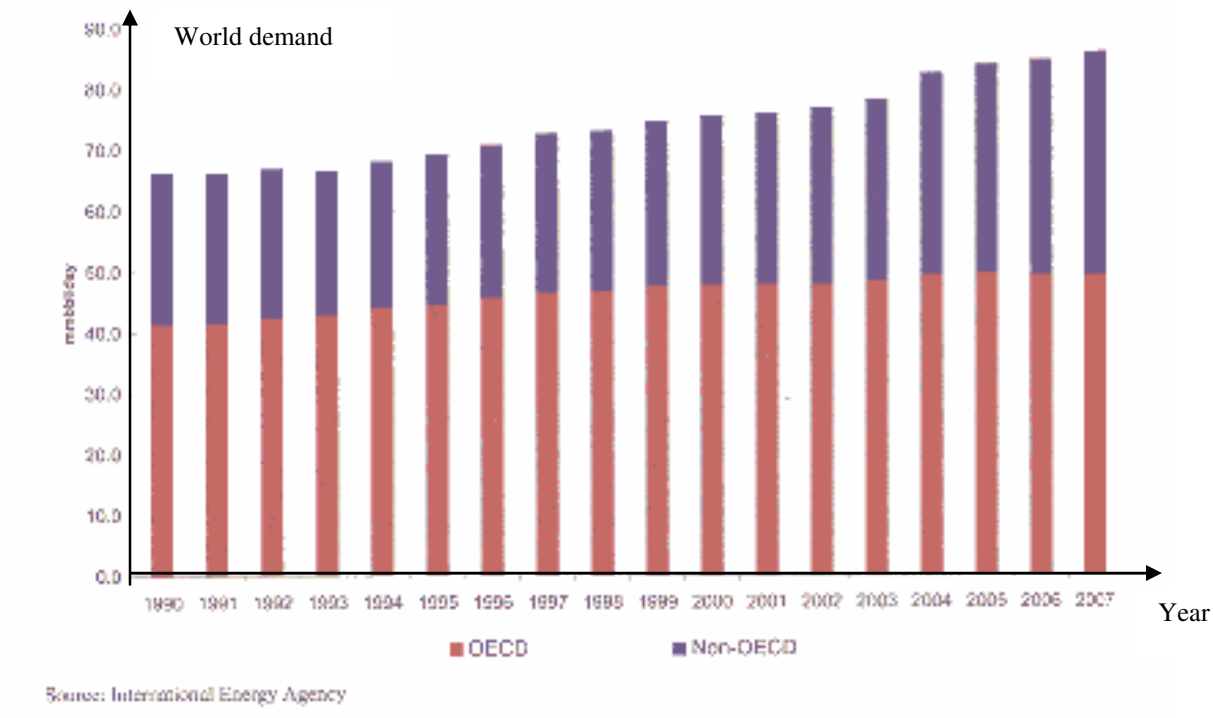
C. a decrease of 1 % approximately

D. an increase of 1 % approximately

E. a decrease of 2 % per year approximately

The following information relates to Questions 5, 6 and 7

Annual world demand for crude oil from 1990 to 2007 (in millions of barrels of oil per day) split between Organisation for Economic Cooperation and Development, OECD countries (bottom of column) and non-OECD countries (top of column) is summarised in the following graph.



Question 5
From 1990 to 2007 the average % growth in annual demand for crude oil is

A. about the same for OECD and non-OECD countries

B. stronger for OECD countries than for non-OECD countries

C. stronger for non-OECD countries than for OECD countries

D. 27% approximately

E. 3.2% approximately.

Question 6
If a linear relationship is used to describe the annual world demand for crude oil and time from 1990 to 2007, the best estimation of the value of r is

A. 0.1 **B.** 0.3 **C.** 0.5 **D.** 0.7 **E.** 0.9

Question 7
If D represents annual world demand for crude oil (in millions of barrels of oil per day) and 1990 is taken as $t = 0$, the best estimate of the least-squares regression line is

A. $D = 1.0t + 60$ **B.** $D = 1.1t + 60$ **C.** $D = 1.1t + 65$ **D.** $D = 1.2t + 65$ **E.** $D = 1.2t + 67$

Question 8

For a set of bivariate data, involving the variables x and y, $r = -0.567$, $\bar{x} = 4.56$, $s_x = 2.61$, and the equation of the least-squares regression line is $y = 30.9 - 1.52x$, the mean and standard deviation of y are closest to

A. 24.0, 7.00 respectively

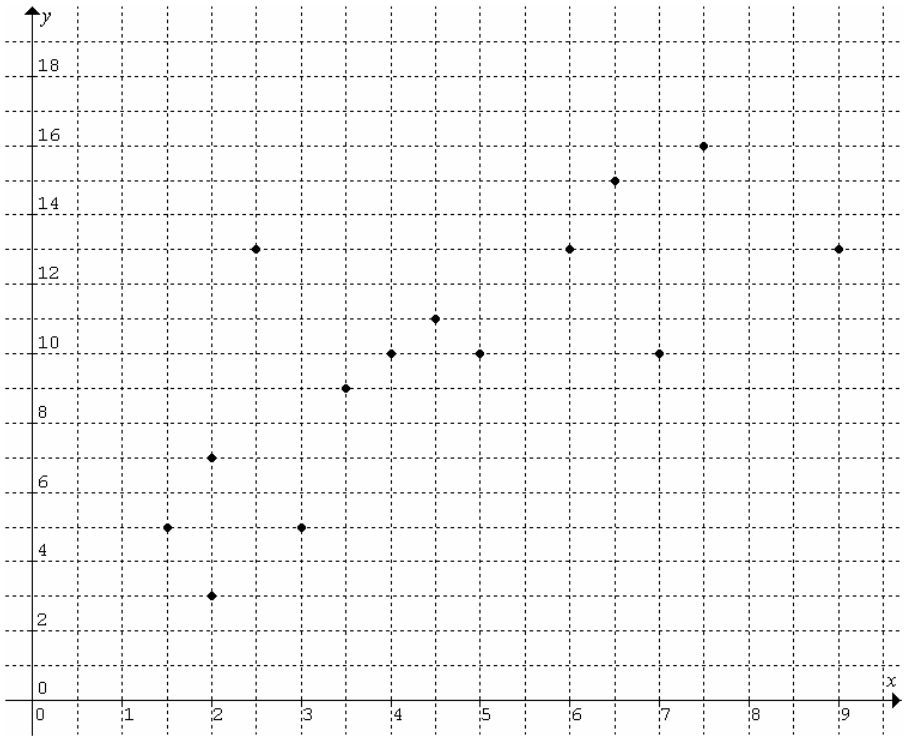
B. 7.00, 24.0 respectively

C. 37.8, −7.00 respectively

D. −7.00, 37.8 respectively

E. −7.00, −37.8 respectively.

The following scatterplot relates to Questions 9 and 10



Question 9

The slope of the three median line of the above set of data is

A. 1.6 **B.** 1.7 **C.** 1.8 **D.** 1.9 **E.** 2.0

Question 10

The point $(6,12)$ is added to the scatterplot, the slope of the three median line of the new set of data is

A. 1.6 **B.** 1.7 **C.** 1.8 **D.** 1.9 **E.** 2.0

Question 11
To linearise the following non-linear data,

x	0	0.3	0.6	0.9	1.2	1.5
y	100	60	40	25	15	10

the best transformation of one of the axes scales is

A. x^2 transformation

B. $\frac{1}{x}$ transformation

C. $\frac{1}{y}$ transformation

D. $\log x$ transformation

E. $\log y$ transformation.

The following information relates to Questions 12 and 13

Total number (**in hundreds**) of computers sold by a company has been recorded for each quarter over the last three years.

Year	March quarter	June quarter	Sept. quarter	Dec. quarter
2005	68	72	79	90
2006	96	104	103	108
2007	100	97	99	93

Question 12
The seasonal index for the June quarter over the three years is closest to

A. 0.99 **B.** 0.98 **C.** 1.02 **D.** 1.01 **E.** 1.00

Question 13
If the seasonal index for the December quarter over the three years is 1.0575, the seasonally adjusted number of computers sold in the December quarter 2006 is closest to

A. 10210 **B.** 11420 **C.** 102 **D.** 121 **E.** 114

SECTION B Instructions

Answer **all** questions
A correct answer scores 1, an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if **more than one** answer is completed for any question.

Module 1: Number patterns

Question 1

The first five terms of a sequence (note: it is neither arithmetic nor geometric) are $\frac{1}{2}$, 2, $\frac{9}{2}$, 8, $\frac{25}{2}$. The next three terms (in order) are

A. 14, $\frac{49}{2}$, 20

B. 20, $\frac{57}{2}$, 44

C. 18, $\frac{49}{2}$, 32

D. 24, $\frac{57}{2}$, 48

E. 14, $\frac{53}{2}$, 32

Question 2

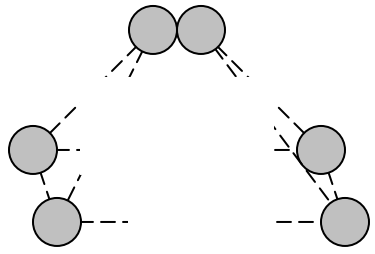
The terms of a sequence are determined by $T_n = \begin{cases} -2+(n-1)5 & for \quad odd \quad n \\ 2^{n-1} & for \quad even \quad n \end{cases}$.

The fourth and fifth terms of the sequence are respectively

A. 6, 13 **B.** 6, 18 **C.** 8, 13 **D.** 8, 18 **E.** 13, 8

Question 3

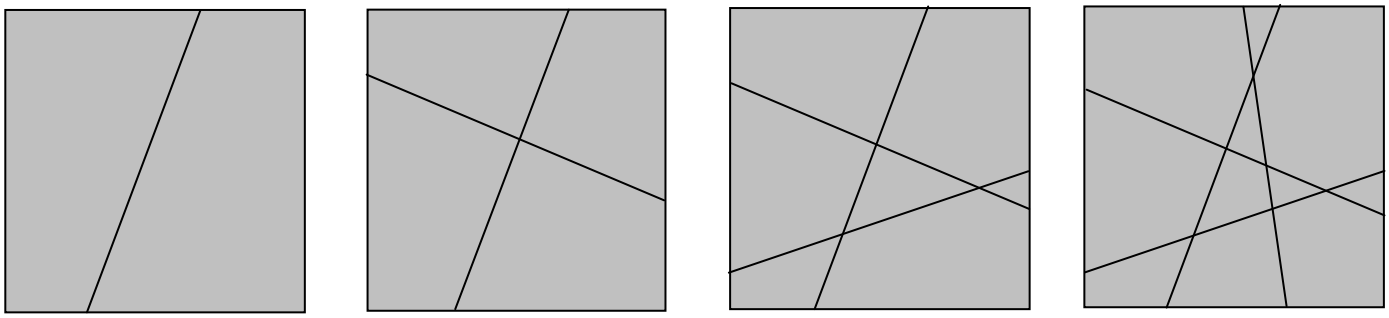
A fruiterer stacks up oranges of the same size in the shape of a rectangular base pyramid. He can stack only two in the top layer and six in the second layer. There are 7 layers in the stacked pyramid.



The total number of oranges in the stacked pyramid is

A. 168 **B.** 280 **C.** 180 **D.** 268 **E.** 208

The following information relates to Questions 4, 5 and 6



A line divides a plane into 2 parts. Two intersecting lines divide the plane into 4 parts. Three lines divide the plane into 7 parts, and so on. Each additional line intersects the existing lines. No two lines are parallel and no three lines are concurrent (i.e. intersect at the same point).

Question 4

The number of parts into which the plane is divided by **five** lines is

A. 14 **B.** 15 **C.** 16 **D.** 17 **E.** 18

Question 5

Given T_n represents the number of parts into which the plane is divided by *n* lines, the difference equation with T_n as the subject of the equation is

A. $T_{n+1} = T_n + n + 1$

B. $T_{n+1} = T_n + n$

C. $T_n = T_{n-1} + n - 1$

D. $T_n = T_{n-1} + n + 1$

E. $T_n = T_{n-1} + n$

Question 6

T_n, the number of parts into which the plane is divided by *n* lines, is

A. $T_n = 1 + 2 + 3 + ... + n$

B. $T_n = \dfrac{n(n+1)}{2}$

C. $T_n = \dfrac{n(n+1)}{2} + 1$

D. $T_n = \dfrac{n(n+1)}{2} - 1$

E. $T_n = 1 + 2 + 3 + ... + (n-1)$

Question 7

The first five terms of a sequence are 2, 3, 5, 8, 13. The **difference** of the next two terms is

A. 11 **B.** 12 **C.** 13 **D.** 14 **E.** 15

Question 8

The difference between S_{20} and S_{22} for the sequence 2, 4, 8, 16, …… is

A. 2^{19} **B.** 2^{20} **C.** 2^{21} **D.** 2^{22} **E.** $3\left(2^{21}\right)$

Question 9

The solution to the equation $t_{n+1} = 5t_n$, when the second term $t_2 = \frac{1}{2}$, is given by

A. $t_n = 0.02\left(5^n\right)$

B. $t_n = 0.5\left(5^{n-1}\right)$

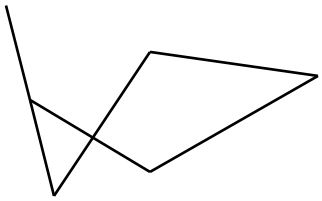
C. $t_{n+1} = \frac{5^{n-2}}{2}$

D. $t_{n+1} = 0.1\left(5^{n-1}\right)$

E. $t_n = \frac{5^{n-2}}{10}$

Module 5: Networks and decision mathematics

Question 1



Which of the following statements is true for the network above?

A. The number of edges equals the sum of the degrees of the vertices.

B. The number of edges is less than the number of vertices.

C. The sum of number of edges and the number of vertices is even.

D. The sum of the degrees of the vertices is double the number of edges.

E. The sum of the degrees of the vertices is odd.

Question 2
A connected planar graph has 8 faces. This graph could **NOT** have

A. 13 edges and 7 vertices

B. 11 vertices and 17 edges

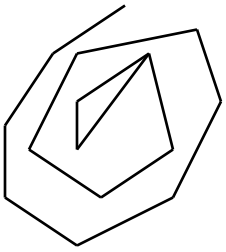
C. 12 edges and 5 vertices

D. 3 vertices and 9 edges

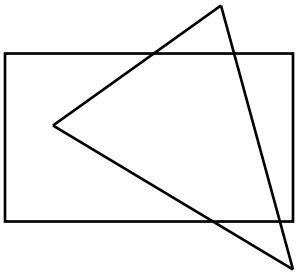
E. 7 edges and a vertex

Question 3
Which one of the following graph does **NOT** have an Euler path?

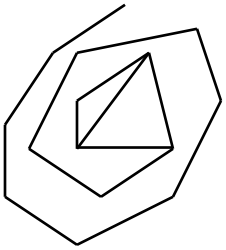
A.



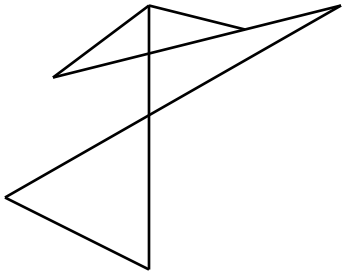
B.



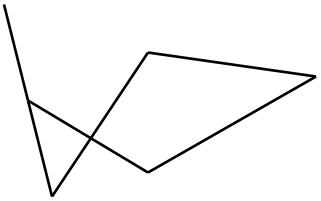
C.



D.



E.



Question 4
Among the choices **A** to **E** in **Question 3**, which of the following statements is true?

A. Only one of them has one or more Hamiltonian paths.

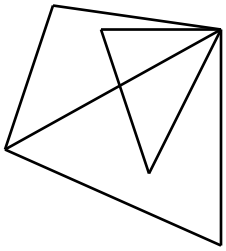
B. Only two of them have one or more Hamiltonian paths.

C. Only three of them have one or more Hamiltonian paths.

D. Only four of them have one or more Hamiltonian paths.

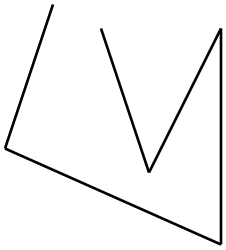
E. All of them have one or more Hamiltonian paths.

Question 5

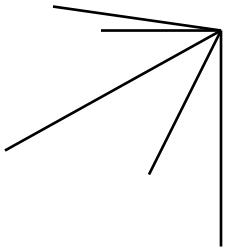


Which one of the following graphs is **NOT** a spanning tree of the above graph?

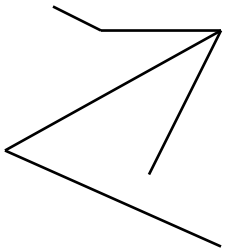
A.



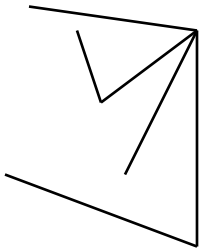
B.



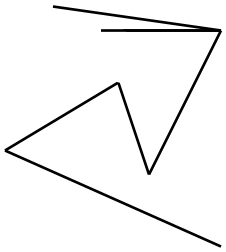
C.



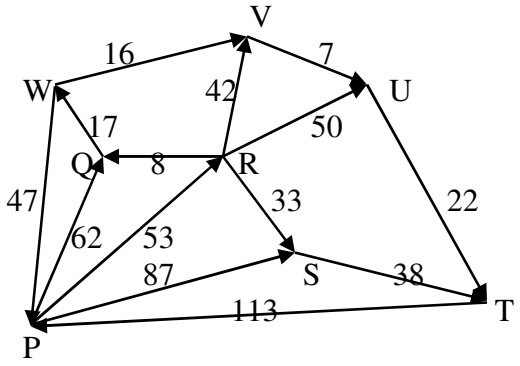
D.



E.



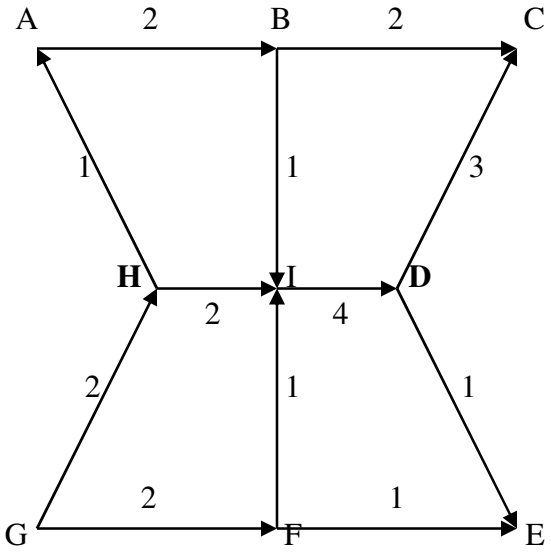
Question 6



The travelling time (in seconds) between various locations in a town are shown in the digraph above. Each edge represents a one-way street. The shortest time (in seconds) to travel from Location P to Location T is

A. 126 **B.** 125 **C.** 124 **D.** 123 **E.** 122

Question 7

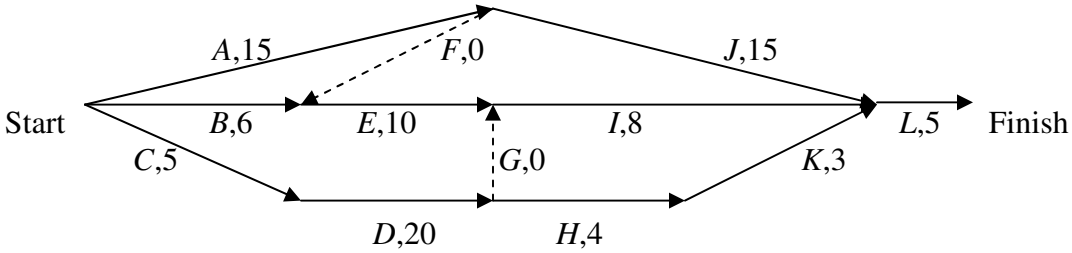


The digraph above represents a system of one-way streets. The numbers show the maximum flow of cars per second in the streets. The maximum flow (in cars per second) from Location H to Location D is

A. 2 **B.** 3 **C.** 4 **D.** 5 **E.** 7

The following information relates to Questions 8 and 9

The digraph indicates the activities *A* to *L*, which are required to complete a project. The times are in hours.



Question 8

A critical path for this project is

A. *BEIL* **B.** *BFJL* **C.** *CDHKL* **D.** *AFEIL* **E.** *AJL*

Question 9

Which one of the following statements is true?

A. The float time, in hours, for activity *J* is 2.

B. The float time, in hours, for activity *K* is 2.

C. The float time, in hours, for activity *D* is 1.

D. The float time, in hours, for activity *I* is 1.

E. The float time, in hours, for activity *H* is 1.

Module 6: Matrices

Question 1

$$\begin{bmatrix} 1 & 0 & -1 \\ 0 & 1 & 2 \end{bmatrix} - \begin{bmatrix} 0 & 1 \\ 1 & 0 \\ -1 & 2 \end{bmatrix}$$

A. $= \begin{bmatrix} 0 & -3 \\ 3 & 0 \end{bmatrix}$ **B.** $= \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$ **C.** $= \begin{bmatrix} -1 & -2 \\ 1 & -4 \end{bmatrix}$ **D.** $= \begin{bmatrix} 0 & -1 & -2 \\ 1 & 0 & -1 \\ -1 & -2 & -3 \end{bmatrix}$ **E.** is not defined

Question 2

Which one of the following statements is true for the matrix product $\begin{bmatrix} 22 \\ 23 \\ 24 \\ 25 \end{bmatrix} \begin{bmatrix} 2 & 3 & 4 & 5 \end{bmatrix}$?

A. It is a column matrix.

B. It is a row matrix.

C. It is not defined.

D. The order of the matrix product is 4×1.

E. The order of the matrix product is 4×4.

Question 3

Matrix X in the equation $X \begin{bmatrix} -2 & 1 & 0 \\ 0 & -1 & 1 \end{bmatrix} = \begin{bmatrix} 4 & -2 & 0 \\ -2 & 2 & -1 \end{bmatrix}$ is

A. not defined.

B. $\begin{bmatrix} -2 & 0 \\ 1 & -1 \\ 0 & 1 \end{bmatrix}$

C. $\begin{bmatrix} 0 & 1 \\ 1 & -1 \\ -2 & 0 \end{bmatrix}$

D. $\begin{bmatrix} -2 & 0 \\ 1 & -1 \end{bmatrix}$

E. $\begin{bmatrix} -2 & 1 & 0 \\ 0 & -1 & 1 \end{bmatrix}$

The following information relates to Questions 4 and 5

In a secondhand book shop all English books are the same price $\$x$, all mathematics books are the same price $\$y$ and all accounting books are the same price $\$z$.

Peter paid \$158 for five English books, two mathematics books and an accounting book; Paul paid \$184 for four English books, three mathematics books and two accounting books; and Mary paid \$162 for three English books, two mathematics books and three accounting books.

x, y and z can be found by the matrix product $N\begin{bmatrix}162\\158\\184\end{bmatrix}$.

Question 4

Matrix N is

A. N^{-1} **B.** $\begin{bmatrix}3&2&3\\5&2&1\\4&3&2\end{bmatrix}$ **C.** $\begin{bmatrix}3&2&3\\5&2&1\\4&3&2\end{bmatrix}^{-1}$ **D.** $\begin{bmatrix}5&2&1\\4&3&2\\3&2&3\end{bmatrix}$ **E.** $\begin{bmatrix}5&2&1\\4&3&2\\3&2&3\end{bmatrix}^{-1}$

Question 5

Matrix $\begin{bmatrix}y\\z\end{bmatrix}$ is

A. $\begin{bmatrix}24\\20\end{bmatrix}$ **B.** $\begin{bmatrix}18\\22\end{bmatrix}$ **C.** $\begin{bmatrix}20\\22\end{bmatrix}$ **D.** $\begin{bmatrix}24\\22\end{bmatrix}$ **E.** $\begin{bmatrix}18\\20\end{bmatrix}$

Question 6

Which one of the following matrices has a **left** multiplicative inverse?

A. $\begin{bmatrix}1&1\\3&4\\0&0\end{bmatrix}$ **B.** $\begin{bmatrix}1&3&0\\1&4&0\end{bmatrix}$ **C.** $\begin{bmatrix}1&1&1\\2&3&4\\0&0&0\end{bmatrix}$ **D.** $\begin{bmatrix}1&2&0\\1&3&0\\1&4&0\end{bmatrix}$ **E.** $\begin{bmatrix}1&1&1\\2&3&4\\3&3&3\end{bmatrix}$

The following information relates to Questions 7, 8 and 9

Three fast food outlets, *P*, *Q* and *R* compete for a fixed number of customers weekly. The following transition matrix is a good indication of the movements of customers among the three outlets from one week to the next week.

	A particular week		
	P	*Q*	*R*
P	0.75	0.12	0.10
Q	0.13	0.72	0.08
R	0.12	0.16	0.82

The following week

Let $\begin{bmatrix} p \\ q \\ r \end{bmatrix}$ be the matrix that indicates the number of customers of *P*, *Q* and *R* respectively in a particular week.

Question 7

Which one of the following statements is true from one week to the next week?

A. 28% of Q's customers go to the other two outlets.

B. 72% of Q's customers go to the other two outlets.

C. 12% of Q's customers go to the other two outlets.

D. 88% of Q's customers go to the other two outlets.

E. 16% of Q's customers go to the other two outlets.

Question 8

In a particular week, $p = 2500$, $q = 3100$ and $r = 1900$. In the sixth week,

A. $p = 2290$, $q = 2068$ and $r = 3141$

B. $p = 2434$, $q = 2440$ and $r = 2346$

C. $p = 2446$, $q = 2465$ and $r = 2323$

D. $p = 2304$, $q = 2114$ and $r = 3082$

E. $p = 2290$, $q = 2068$ and $r = 3142$

Question 9

Two weeks before that particular week, the number of customers of *R* is

A. 187 **B.** 573 **C.** 1573 **D.** 1673 **E.** 1873

End of Exam 1

