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Further Mathematics

2006

Trial Examination 1

Core – Data analysis
Module 1 – Number patterns
Module 2 – Geometry and trigonometry
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 table below shows the sale price (to the nearest thousand dollars) and condition of ten houses sold in Heavenvale.

Price ($)	Condition
276000	Fair
308000	Good
269000	Excellent
202000	Poor
373000	Good
330000	Excellent
288000	Good
199000	Fair
225000	Fair
259000	Poor

Question 1
The types of data displayed for sale price and condition are respectively

A. continuous numerical data, discrete data

B. discrete numerical data, categorical data

C. continuous numerical data, categorical data

D. discrete numerical data, discrete data

E. discrete numerical data, continuous categorical data

Question 2
The median price to the nearest thousand dollars for the ten houses sold is

A. $272500

B. $272000

C. $273000

D. $273500

E. $276000

The following information relates to Questions 3 and 4

The following stemplot displays the mathematics test marks of a class of 33 students.

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

Question 3
The interquartile range of the test marks is

A. 21 **B.** 21.5 **C.** 22 **D.** 22.5 **E.** 23

Question 4
The number of outliers in the data is/are

A. 0 **B.** 1 **C.** 2 **D.** 3 **E.** 4

Question 5
The scores of car driving test last year follow a normal distribution. A driver's standardised score on the test is $z = -1.5$. The driver's score is

A. in the bottom 16% but not in the bottom 2.5%

B. in the top 16% but not in the top 2.5%

C. in the bottom 2.5% but not in the bottom 0.15%

D. in the top 2.5 % but not in the top 0.15%

E. in the bottom 0.15%

The following information relates to Questions 6 and 7

The exam scores for English, Mathematics and Science for year nine students at Heavenvale High can be modeled by normal distributions. The mean and standard deviation for each of the subjects are shown in the following table.

Subject	Mean	Standard deviation
English	74	12
Mathematics	61	18
Science	70	10

Question 6
The percentage of students who score higher than 80 in Science is

A. 32% **B.** 20% **C.** 18% **D.** 16% **E.** 5%

Question 7
Jill's scores are 80 for English, 70 for Mathematics and 80 for Science. Which one of the following statements is correct?

A. Jill has the same ranking in English and Science.

B. Jill has the same ranking in Mathematics and Science.

C. Jill has the same ranking in English and Mathematics.

D. Jill has a higher ranking in Mathematics among the three subjects.

E. Jill has a lower ranking in Science among the three subjects.

Question 8
Consider the following scatterplot.

The best description of the association between x and y is

A. negative, non-linear and weak

B. negative, linear and weak

C. negative, linear and moderate

D. positive, linear and strong

E. positive, non-linear and moderate

Question 9
The least squares regression line for a set of data is determined to be $y = 5.6 - 0.81x$. The residual value for the data point $(2,3)$ is

A. 1.0 **B.** 0.9 **C.** 0.10 **D.** – 0.9 **E.** – 1.0

The following information relates to Questions 10 and 11

A bivariate data has the following statistics:

$\bar{x} = 1.30$, $\bar{y} = 5.28$, $s_x = 0.243$, $s_y = 1.72$, $r = -0.8913$

Question 10
When $x = 0$, the value of y predicted by its least squares regression line $y = a + bx$ is closest to

A. 14 **B.** 13 **C.** – 2.9 **D.** – 13 **E.** – 14

Question 11
The equation of the least squares regression line for the bivariate data is

A. $y = 13.5 - 6.3x$

B. $y = 13.5x - 6.3$

C. $y = 13.5 + 6.3x$

D. $y = 13.5x + 6.3$

E. $y = -13.5x + 6.3$

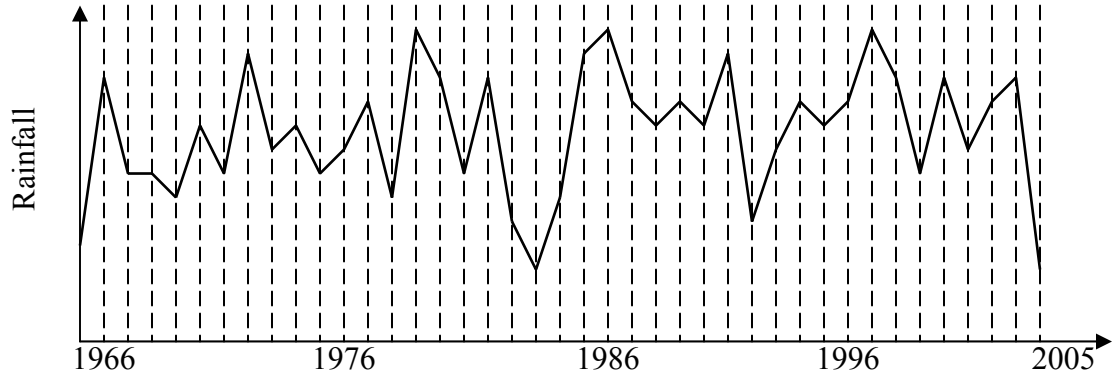
Question 12
The four quarterly sales (in thousands of dollars) of an electrical store last year are shown together with the corresponding seasonal indices for the first three quarters in the following table.

	First quarter	Second quarter	Third quarter	Fourth quarter
Quarterly sales	589.3	447.8	507.3	639.5
Seasonal indices	0.93	0.90	0.85	

The deseasonalised sales for the fourth quarter last year was closest to

A. \$640 **B.** \$640000 **C.** \$840 **D.** \$840000 **E.** \$480000

Question 13
The annual rainfall at a particular location in Australia over the last 40 years is presented in the following time series.



The pattern of the annual rainfall over the last 40 years shows

A. seasonal variation and increasing trend

B. random variation and increasing trend

C. cyclical variation and increasing trend

D. seasonal variation and decreasing trend

E. random variation and decreasing trend

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 and applications

Question 1
Which one of the following sequences is arithmetic?

A. 1, 4, 9, 16, 25, 36, ……

B. $-1, -3, -6, -10, -15, \ldots\ldots$

C. $\frac{1}{3}, \frac{1}{4}, \frac{1}{5}, \frac{1}{6}, \frac{1}{7}, \ldots\ldots$

D. $1-\frac{1}{3}, 1-\frac{2}{3}, 0, 1-\frac{4}{3}, 1-\frac{5}{3}, \ldots\ldots$

E. $-1, 2, -4, 8, -16, \ldots\ldots$

Question 2
The following sequence is geometric.

28.08, x, 3.12, 1.04, ……

The missing term, denoted by x, is

A. 9.36 **B.** 15.60 **C.** 2.08 **D.** 26.00 **E.** 5.20

Question 3
Consider the following sequence.

−1, 0, 3, 8, 15, 24, ……, 99

The last term of the sequence is 99. The number of terms in the sequence is

A. 12 **B.** 11 **C.** 10 **D.** 9 **E.** 7

Question 4
The sequence shown below is an infinite geometric sequence.

$$-\frac{1}{2}, \frac{1}{6}, -\frac{1}{18}, \frac{1}{54}, \ldots\ldots\ldots$$

The sum of the terms in the sequence is

A. $-\frac{3}{8}$ **B.** $\frac{3}{8}$ **C.** $-\frac{3}{4}$ **D.** $\frac{3}{4}$ **E.** $-\frac{2}{3}$

Question 5
The sum of the middle two terms of an arithmetic sequence is 109. The sum of the first and the last terms of the sequence is

A. 149 **B.** 139 **C.** 129 **D.** 119 **E.** 109

Question 6
The following sequence is generated by the difference equation $T_{n+1} = 2T_n - 9$.

……, 12.5, p, a, w, …… where p, a and w are the next three terms after 12.5.

The term, denoted by w, is

A. 16 **B.** 23 **C.** 37 **D.** 65 **E.** 121

Question 7

A sequence is generated by the difference equation $u_n = \frac{1}{2}u_{n-1} - 9$. If $u_5 = 3$, then u_1 is

A. 318 **B.** 183 **C.** 87 **D.** 78 **E.** 39

Question 8

A sequence is generated from the difference equation $t_{n+1} = at_n + b$ where $t_1 = \frac{1}{3}$.

The sequence is geometric if

A. $a = -1,\ b = 2$

B. $a = -2,\ b = 1$

C. $a = -3,\ b = 0$

D. $a = -4,\ b = -1$

E. $a = -5,\ b = -2$

Question 9

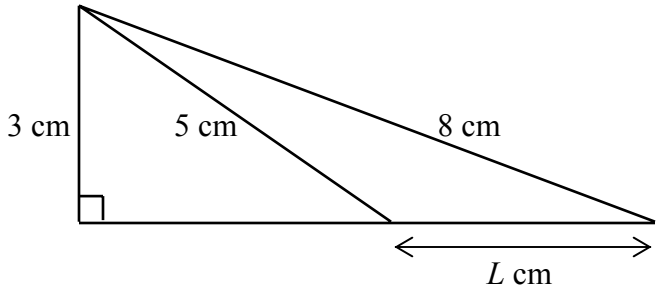
A sequence is generated from the difference equation $t_{n+2} = t_{n+1} + t_n$ where $t_1 = t_2 = 1$.

The value of $t_8 \times t_5 - t_7 \times t_6$ is

A. -2 **B.** -1 **C.** 0 **D.** 1 **E.** 2

Module 2: Geometry and trigonometry

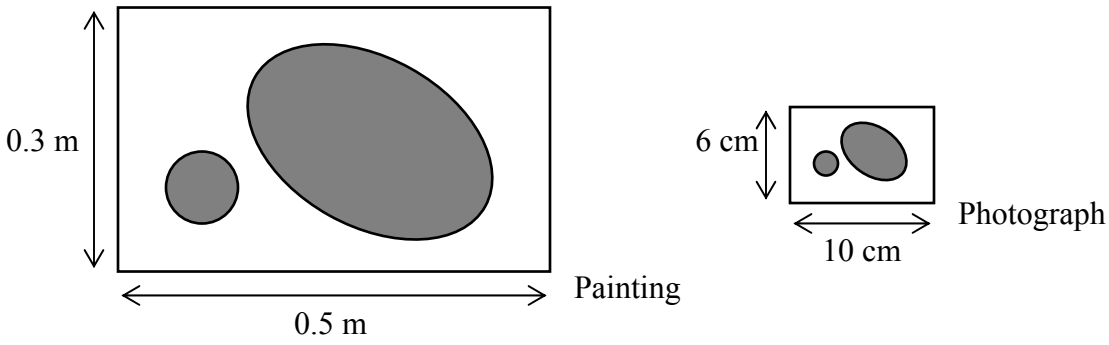
Question 1



The value of L in the diagram above is closest to

A. 3.1 **B.** 3.2 **C.** 3.3 **D.** 3.4 **E.** 6.2

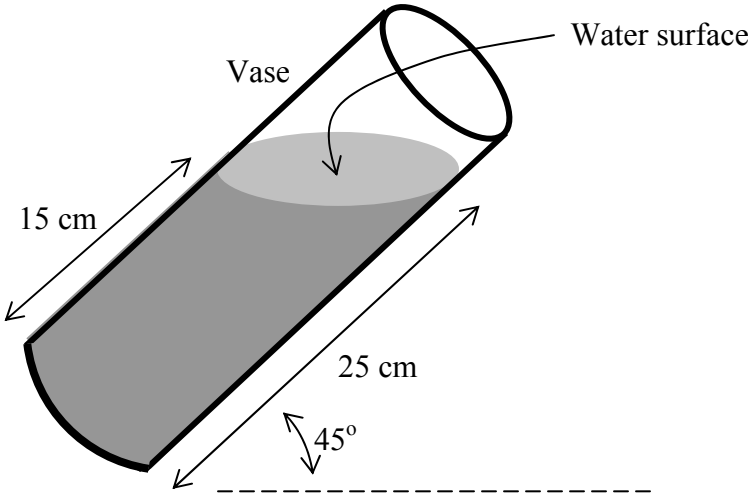
Question 2
A painting and its photograph are shown below.



The scale factor of the shaded area in the photograph is

A. 0.2 **B.** 25 **C.** 20 **D.** 0.05 **E.** 0.04

The following information relates to Questions 3 and 4



The interior **diameter** of the cylindrical vase is 10 cm. It is tilted at 45^o when it is filled with water until the water level is at the 15 cm mark on one side and 25 cm mark on the other side.

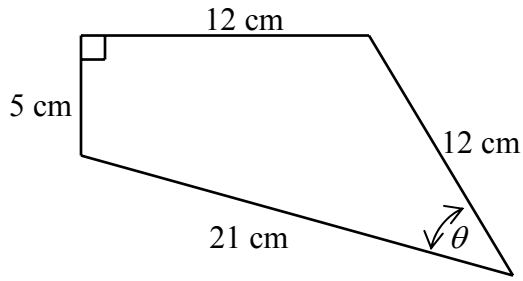
Question 3
The volume (in litres) of water in the vase is closest to

A. 1.6 **B.** 1.4 **C.** 6.3 **D.** 5.6 **E.** 4.4

Question 4
The area (in cm^2) of the water surface is closest to

A. 100 **B.** 110 **C.** 120 **D.** 130 **E.** 140

The following information relates to Questions 5 and 6



Question 5
The total area (in cm^2) of the region enclosed by the quadrilateral is closest to

A. 100 **B.** 110 **C.** 120 **D.** 130 **E.** 140

Question 6
The value of angle θ in degrees is closest to

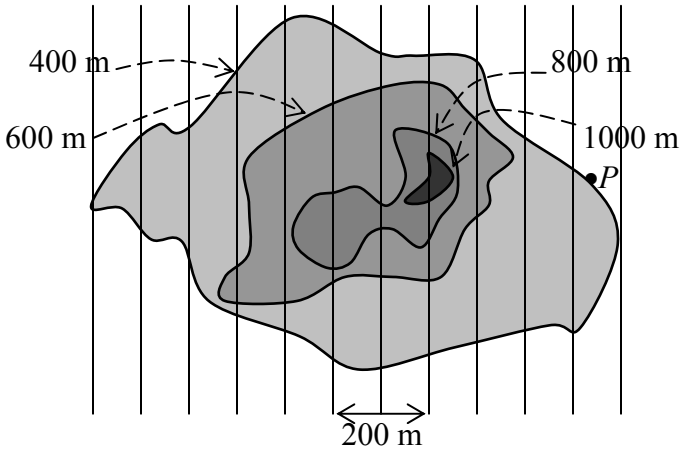
A. 30 **B.** 35 **C.** 40 **D.** 45 **E.** 50

Question 7
The location of a house is 720 m N72°W of Heavenvale Shopping Centre. The true bearing of Heavenvale Shopping Centre from the house is

A. 072° T **B.** 108° T **C.** 252° T **D.** 288° T **E.** 342° T

The following information relates to Questions 8 and 9

Contour map



Question 8
The average slope between point *P* and the summit is closest to

A. 4 **B.** 3 **C.** 2 **D.** 1.5 **E.** 1

Question 9
The angle of depression from the summit to point P is closest to

A. 25° **B.** 65° **C.** 75° **D.** 15 **E.** 30°

Module 6: Matrices

Question 1

$\begin{bmatrix} 2 & -1 & 0 & 3 & 1 \\ -3 & -2 & 5 & 0 & 0 \\ 4 & 3 & -1 & -2 & 3 \\ 4 & 2 & 0 & 5 & -7 \end{bmatrix}$ is

A. a singular matrix

B. not a transition matrix

C. a 5×4 matrix

D. an inverse matrix

E. a diagonal matrix

Question 2

$2\begin{bmatrix} 0 & 1 \\ 1 & 2 \\ 2 & 3 \end{bmatrix} - \frac{1}{2}\begin{bmatrix} 0 & 4 \\ 4 & 8 \\ 8 & 12 \end{bmatrix}$ equals

A. 0

B. $[0]$

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

D. $\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$

E. $\frac{3}{2}\begin{bmatrix} 0 & -3 \\ -3 & -6 \\ -6 & -9 \end{bmatrix}$

Question 3

If $A\begin{bmatrix} a & b & c & d \\ e & f & g & h \\ i & j & k & l \end{bmatrix} = \begin{bmatrix} m & n & o & p \\ q & r & s & t \end{bmatrix}$, then the order of matrix A is

A. 4×4 **B.** 3×2 **C.** 2×3 **D.** 2×4 **E.** 4×2

Question 4

If $\begin{bmatrix} a & b \\ c & d \end{bmatrix}\begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ 1 & 1 \end{bmatrix}$, then

A. $a=1,\ b=-1,\ c=1$ and $d=0$

B. $a=-1,\ b=1,\ c=0$ and $d=1$

C. $a=1,\ b=0,\ c=1$ and $d=-1$

D. $a=0,\ b=1,\ c=-1$ and $d=1$

E. $a=1,\ b=-1,\ c=1$ and $d=-1$

Question 5

The inverse of $\begin{bmatrix} 1 & -1 \\ 1 & -2 \end{bmatrix}$ is

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

Question 6

Given $\begin{bmatrix} 1 & -2 \\ -3 & 4 \end{bmatrix}\begin{bmatrix} p & q \\ r & s \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ where p, q, r and s are real numbers, the solution of the matrix equation $\begin{bmatrix} p & q \\ r & s \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} -\frac{1}{2} \\ \frac{1}{4} \end{bmatrix}$ is

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

The following information relates to Questions 7 and 8

Sign **S** and sign **T** have a large number of light globes. On a given night only 95% of the light globes are working when sign **S** is turned on, and only 30% of the non-working light globes are replaced by new working light globes. Only 50% of the globes are working when sign **T** is turned on, and only 50% of the non-working light globes are replaced by new working light globes.

Question 7

The transition matrix for sign **S** that can be used to determine the number of working light globes after replacing 30% of the non-working ones on any subsequent night is

A. $\begin{bmatrix} 0.05 & 0.70 \\ 0.95 & 0.30 \end{bmatrix}$ **B.** $\begin{bmatrix} 0.05 & 0.30 \\ 0.95 & 0.70 \end{bmatrix}$ **C.** $\begin{bmatrix} 0.95 & 0.05 \\ 0.30 & 0.70 \end{bmatrix}$ **D.** $\begin{bmatrix} 0.95 & 0.30 \\ 0.05 & 0.70 \end{bmatrix}$ **E.** $\begin{bmatrix} 0.05 & 0.95 \\ 0.70 & 0.30 \end{bmatrix}$

Question 8

The transition matrix for sign **T** that can be used to determine the number of working light globes after replacing 50% of the non-working ones on any subsequent night is $\begin{bmatrix} 0.50 & 0.50 \\ 0.50 & 0.50 \end{bmatrix}$. On a given night there are 120 working and 60 non-working light globes. A month later the number of working light globes after replacing 50% of the non-working ones is

A. 70 **B.** 80 **C.** 90 **D.** 100 **E.** 110

Question 9

The matrix equation that could represent the system of simultaneous linear equations $3y = 2$ and $y = 5x - 1$ is

A. $\begin{bmatrix} 3 & 0 \\ -1 & 5 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 2 \\ 1 \end{bmatrix}$

B. $\begin{bmatrix} 0 & 3 \\ 5 & -1 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 2 \\ -1 \end{bmatrix}$

C. $\begin{bmatrix} 0 & 3 \\ 5 & -1 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 2 \\ 1 \end{bmatrix}$

D. $\begin{bmatrix} 3 & 0 \\ -1 & 5 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 2 \\ -1 \end{bmatrix}$

E. $\begin{bmatrix} 0 & 3 \\ -1 & 5 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 2 \\ 1 \end{bmatrix}$

End of Exam 1