2010 Further Mathematics Trial Examination 1 Suggested Solutions

# 2010

### VCE Further Mathematics Trial Examination 1

## **Suggested Solutions**

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#### Core: Data analysis

Question 1 C	Question 2 B
The mean will change because the sum of the	The highest reading at both sites is 78
values will be less. This means that the variance	The lowest reading at site A is 34
and standard deviation will also change	The median at site A is 51.5
The range will change because the maximum	The median at site B is 53
value will now be 17 instead of 10	The interquartile range for site B is
The interquartile range will remain $15 - 10 - 5$	Fine interquartice range for site B is $44 - 185$
The interquartice range will remain $15 - 10 - 5$	02.3 - 44 = 10.3
Question 3 A	Question 4 B
The whiskers each contain 25% of the scores.	Number female labour voters $= 27$
Only one of Anna's whiskers is longer than the	Total number of labour voters $= 52$
largest of Belinda's scores, so 75% of Anna's	52
scores are less than Belinda's highest score.	% labour voters = $\frac{1}{55+62} \times 100 = 44\%$
The box for Anna is longer than the box for	55 1 62
Belinda so Anna's IQR is larger than Belinda's	
IQR.	
Belinda's scores are not skewed.	
Anna's scores are positively skewed.	
Question 5 D	Question 6 D
= 80 - 70	7 19-25
$Z_{Eng} = \frac{10}{10} = 1$	$Z = \frac{1}{3} = -2$
85 - 70	95% lie within 2 standard deviations of the mean
$Z_{Biol} = \frac{65 - 76}{15} = 1$	
15	so 5% lie outside. $2.5\%$ are less than $-2$ so $2.5\%$
$Z_{\rm m} = \frac{95-67}{1} = 1.9$	are less than 19.
$-P_{hys}$ 15	Hence $100 - 2.5 = 97.5\%$ are greater than 19
7 - 75 - 55 - 2	
$Z_{Chem} = \frac{10}{10} = 2$	
80-60	
$Z_{Math} = \frac{12}{12} = 1.7$	
Chemistry has the highest $Z$ score so it is the	
subject she did best in relative to the others in	
her class.	

#### Core: Data analysis

Question 7 E	Question 8 B		
Gender and employment classification are both	The time series shows a seasonal pattern only.		
categorical data. The back to back stem and leaf	Since the pattern is roughly the same for each		
and the parallel box plots are used for comparing	since the pattern is roughly the same for each		
the numerical values of one set of astagorical	year, there is no linear trend. A cyclical pattern		
dete a gender. A sectter plat is used for two	is a pattern over a longer period of time than a		
data, e.g. gender. A scatter plot is used for two	quarter or season.		
numerical variables. A histogram is used for a			
frequency distribution of numerical data.			
Question 9 E	Question 10 A		
For a TI-83 calculator go to stat edit. Enter the	Using the same calculator screen as for question		
Age values in $L_1$ and the blood pressures in $L_2$	9,		
Go to stat calc linear regression $(ax + b)$ . Press	$r^2 = 0.75$		
$L_1, L_2$ and read the value $a = 1, b = 84.98$			
Question 11 C	Question 12 A		
The median of the lowest three points is	Residual Value = Actual value – Predicted		
(25,110) and the median of the upper three	Value. Hence, points above the line will be		
points is (73,164)	positive and points below the line will be		
164 - 110			
$m = \frac{1}{73 - 25} = 1.125$	The distance above or below the line in the		
13-25	question is the distance above or below the zero		
	line in the answer		
Question 13 B			
SL for third quarter $= 4 - (0.59 \pm 1.24 \pm 0.81) - 1.3$	6		
51101  unit quarter = 4 - (0.59 + 1.24 + 0.01) = 1.5	0		
SI – <u>actual figure</u>			
$\frac{51}{\text{deseasonalised figure}}$			
actual figure 32465			
Deseasonalised figure = $\frac{actual ligure}{max} = \frac{32403}{1.26} = $23,871$			
<u> </u>			

#### Module 1 Number patterns

Question 1 B	Question 2 D
The pattern of this arithmetic sequence is	a + d = 9
subtracting 5, so <i>a</i> is 5 more than -2, i.e. $a = 3$	a + 4d = 12
	a + d + 3d = 12
	9 + 3d = 12
	3d = 3
	d = 1
	a = 9 - 1 = 8
	$S_n = \frac{n}{2} \left[ 2a + (n-1)d \right]$
	$S_6 = \frac{6}{2} [16 + 5 \times 1] = 63$
Question 3 C	You can also use your calculator in sequence
This is a geometric sequence with $a = 2$ and $r = 4$	mode to solve this question.
This is a geometric sequence with $a = 2$ and $r = 4$ $t_n = ar^{n-1} = 2 \times 4^{n-1} = 32768$	mode to solve this question. <b>Press</b> y =
This is a geometric sequence with $a = 2$ and $r = 4$ $t_n = ar^{n-1} = 2 \times 4^{n-1} = 32768$ $4^{n-1} = 16384$	mode to solve this question. <b>Press</b> y = nMin = 1
This is a geometric sequence with $a = 2$ and $r = 4$ $t_n = ar^{n-1} = 2 \times 4^{n-1} = 32768$ $4^{n-1} = 16384$ $4^{n-1} = 4^7$	mode to solve this question. <b>Press</b> y = nMin = 1 $u(n) = 4 \land (n - 1)$
This is a geometric sequence with $a = 2$ and $r = 4$ $t_n = ar^{n-1} = 2 \times 4^{n-1} = 32768$ $4^{n-1} = 16384$ $4^{n-1} = 4^7$ n-1 = 7	mode to solve this question. <b>Press</b> y = nMin = 1 $u(n) = 4 \land (n-1)$ u(nMin) = 0
This is a geometric sequence with $a = 2$ and $r = 4$ $t_n = ar^{n-1} = 2 \times 4^{n-1} = 32768$ $4^{n-1} = 16384$ $4^{n-1} = 4^7$ n - 1 = 7 n = 8	mode to solve this question. <b>Press</b> y = nMin = 1 $u(n) = 4 \land (n-1)$ u(nMin) = 0 Press 2nd table to get when $n = 8$ , $y = 16384$
This is a geometric sequence with $a = 2$ and $r = 4$ $t_n = ar^{n-1} = 2 \times 4^{n-1} = 32768$ $4^{n-1} = 16384$ $4^{n-1} = 4^7$ n - 1 = 7 n = 8	mode to solve this question. <b>Press</b> y = nMin = 1 $u(n) = 4 \land (n-1)$ u(nMin) = 0 Press 2nd table to get when $n = 8$ , $y = 16384$ Here $4 \land (8-1) = 16384$
This is a geometric sequence with $a = 2$ and $r = 4$ $t_n = ar^{n-1} = 2 \times 4^{n-1} = 32768$ $4^{n-1} = 16384$ $4^{n-1} = 4^7$ n - 1 = 7 n = 8	mode to solve this question. <b>Press</b> y = nMin = 1 $u(n) = 4 \land (n-1)$ u(nMin) = 0 Press 2nd table to get when $n = 8$ , $y = 16384$ Here $4 \land (8-1) = 16384$ so $4^7 = 16384$
This is a geometric sequence with $a = 2$ and $r = 4$ $t_n = ar^{n-1} = 2 \times 4^{n-1} = 32768$ $4^{n-1} = 16384$ $4^{n-1} = 4^7$ n - 1 = 7 n = 8	mode to solve this question. <b>Press</b> y = nMin = 1 $u(n) = 4 \land (n-1)$ u(nMin) = 0 Press 2nd table to get when $n = 8$ , $y = 16384$ Here $4 \land (8 - 1) = 16384$ so $4^7 = 16384$ n-1=7
This is a geometric sequence with $a = 2$ and $r = 4$ $t_n = ar^{n-1} = 2 \times 4^{n-1} = 32768$ $4^{n-1} = 16384$ $4^{n-1} = 4^7$ n-1=7 n = 8	mode to solve this question. <b>Press</b> y = nMin = 1 $u(n) = 4 \land (n-1)$ u(nMin) = 0 Press 2nd table to get when $n = 8$ , $y = 16384$ Here $4 \land (8-1) = 16384$ so $4^7 = 16384$ n-1=7 n = 8

#### Module 1 Number patterns

Question 4 D	Question 5 A
$r = \frac{1}{4} \div \frac{1}{2} = \frac{1}{2}$ $S_{\infty} = \frac{a}{1-r} = 6$ $S_{4} = \frac{a(1-r^{4})}{1-r} = \frac{a}{1-r} \times (1-r^{4}) = 6 \times (1-\left(\frac{1}{2}\right)^{4})$ $S_{4} = 5\frac{5}{8}$	$t_{n+1} = t_n + 3n$ $t_2 = t_1 + 3 \times 1 == 4 + 3 = 7$ $t_3 = t_2 + 3 \times 2 == 7 + 6 = 13$ $t_4 = t_3 + 3 \times 3 == 13 + 9 = 22$ $t_5 = t_4 + 3 \times 4 == 22 + 12 = 34$ 4,7,13,22,34
Question 6 E	Question 7 C
$t_3 = 2t_2 + 3t_1 = 2 + 3 = 5$	This is an arithmetic sequence with $a = 64$
$t_4 = 2t_3 + 3t_2 = 2 \times 5 + 3 \times 1 = 13$	and $d = -4$
	Each term is found by subtracting 4
	from the previous term.
	$\mathbf{t}_{n+1} = t_n - 4$
Question 8 C	Question 9 D
Put calculator in sequence mode.	10, 8, 6.4
Press	This is a geometric sequence with $r = 0.8$
<i>y</i> =	$S_{\infty} = \frac{a}{1-r} = \frac{10}{1-0.8} = 50$ cm.
nMin = 1	1-7 1-0.0
u(n) = 1.0045u(n-1) + 2600	
u(nMin) = 20,000	
Press 2nd table to get when $n = 11$ , $u(n) = 47451$	

#### Module 2 Geometry and trigonometry

Question 1 B	Question 2 F
	VV7 = 180 (20 ± 55) = 05
$\sin\theta = \frac{12}{12}$	$2A12 = 180 = (30 \pm 33) = 93$
28	Using the sine rule
$a = \frac{1}{12} (12) = 25^{0}$	x v
$\theta = \sin \left( \frac{1}{28} \right) = 25$	$\frac{1}{\sin 20^0} = \frac{1}{\sin 05^0}$
(20)	
	$y \sin 30^{\circ}$
	$x = \frac{1}{\sin 95^{\circ}}$
Question 3 D North	Question 4 D
Т	$A_{N}$
	300 600
. \	
A	
	В
×56°	200
	$\sin \theta - \frac{300}{2}$
B	<sup>5110</sup> – 600
	$a = \frac{1}{300}$ and
Bearing of B from A is measured from North	$\theta = \sin^{-1} \left  \frac{1}{600} \right  = 30^{\circ}$
$= 180 + 56 = 236^{\circ} T$	
	Gradient = $\tan \theta = \tan 30^{\circ} = 0.58$
	This is closest to 0.6
Question 5 D	
Triangles ABE and EDC are similar (SAS)	
Hence, the sides are in the same ratio.	
Each side in triangle $ABF$ is 4 times its	
corresponding side in triangle EDC	
$AD = A \times A5 = 19 \text{ m}$	
$AD = 4 \times 4.3 = 18 \text{ m}.$	

#### Module 2 Geometry and trigonometry



#### Module 3 Graphs and relations

<b>Question 1 A</b> From April to May the rainfall decreases from 40 to 20 mm. This is the biggest decrease between any two consecutive months.	Question 2 D At least 20 means 20 or more than 20. This happens in January, February, March, April, for most of September, October, November, December. i.e. approximately 8 months.
Question 3 C	Ouestion 4 B
The line $2x + y = 18$ is the line with the points	Toll = $12 + x(p-1) = 12 + xp - x$
(0,18) and $(9,0)$ . <i>y</i> is greater than or equal to this line so the regions are limited to R and T. The other line, containing the points $(0,-2)$ and $(4,0)$ is the line $x - 2y = 4$ . – <i>y</i> is less than or equal to this line so <i>y</i> must be greater than or equal to this line. This gives the regions P, Q and R. the only region common to both is R.	Toll = \$(xp - x + 12)
Question 5 C	Question 6 C
	F = 1.8C + a
$m = \frac{y_2 - y_1}{y_2 - y_1} = \frac{212 - 50}{212 - 50} = \frac{162}{1.8} = 1.8$	$50 = 1.8 \times 10 + a$
$x_2 - x_1 = 100 - 10 = 90$	a = 50 - 18 = 32
	F = 1.8c + 32
	$F = 1.8 \times 30 + 32 = 86^{\circ}$

#### Module 3 Graphs and relations

Question 7 D	Question 8 D	
Let basic wage be x and wage after 11.00 pm be 19x + 6y = 784 (1) 13x + 8y = 700 (2) (1) × 4 → 76x + 24y = 3136 (1a) (2) × 3 → 39x + 24y = 2100 (2a) (1a) - (2a) → 37x = 1036 x = \$28 Substitute this value for x in (1) $19 \times 28 + 6y = 784$ 6y = 252 y = \$42	y = $-px - r$ -p is negative since the slope of the line is negative so p is positive. -r is positive as can be seen from the y intercept so r is negative	
Question 9 B		

The vase would fill rapidly at first, since the base of the vase is narrow, then more slowly as the vase broadens. Hence, the graph is not linear at any stage so not C, D, or E. A shows a vase that is filling more quickly with time. The answer is B.

#### Module 4 Business-related mathematics

Question 1 C	Question 2 B		
I = PRT	Let amount of depreciation per year = $x$		
$I = \frac{1}{100}$	7500 - 10x = 1400		
$I = \frac{45,000 \times R \times 6}{25,000 \times R \times 6} = 25,110$	6100 = 10x		
100	x = \$610		
$R = \frac{25,110 \times 100}{45,000 \times 6} = 9.3\%$			
Question 3 F	Question 4 C		
Amount owing = $6600 - 1000 = 5600$	100% - 7% = 93%		
Amount paid over 36 months = $180 \times 36 = 6480$	Value = $3500(0.93)^9 = $1821$		
Interest = $6480 - 5600 = $880$			
Question 5 A	Question 6 D		
Question 5 A The scrap value is \$2000	<b>Question 6 D</b> Tax payable on $$78,000 = 4,350 +$		
<b>Question 5</b> A The scrap value is \$2000 The office equipment is written off after 6 years.	<b>Question 6 D</b> Tax payable on $$78,000 = 4,350 + 30$		
<b>Question 5</b> A The scrap value is \$2000 The office equipment is written off after 6 years. The rate of depreciation is the gradient of the	Question 6 D Tax payable on \$78,000 = 4,350 + $(78,000 - 35,000) \times \frac{30}{100}$		
Question 5 A The scrap value is \$2000 The office equipment is written off after 6 years. The rate of depreciation is the gradient of the line 2-8	Question 6 D Tax payable on \$78,000 = 4,350 + $(78,000 - 35,000) \times \frac{30}{100}$ Tax payable on \$78,000 = \$17,250		
Question 5 A The scrap value is \$2000 The office equipment is written off after 6 years. The rate of depreciation is the gradient of the line $\frac{2-8}{6-0} = -1$	Question 6 D Tax payable on \$78,000 = 4,350 + $(78,000 - 35,000) \times \frac{30}{100}$ Tax payable on \$78,000 = \$17,250 Tax payable on \$85,000 = 17,850 +		
Question 5 A The scrap value is \$2000 The office equipment is written off after 6 years. The rate of depreciation is the gradient of the line $\frac{2-8}{6-0} = -1$ The negative indicates depreciation. Hence	Question 6 D Tax payable on \$78,000 = 4,350 + $(78,000 - 35,000) \times \frac{30}{100}$ Tax payable on \$78,000 = \$17,250 Tax payable on \$85,000 = 17,850 + $(85,000 - 80,000) \times \frac{38}{100}$		
Question 5 A The scrap value is \$2000 The office equipment is written off after 6 years. The rate of depreciation is the gradient of the line $\frac{2-8}{6-0} == -1$ The negative indicates depreciation. Hence depreciation is \$1,000 per year.	Question 6 D Tax payable on \$78,000 = 4,350 + $(78,000 - 35,000) \times \frac{30}{100}$ Tax payable on \$78,000 = \$17,250 Tax payable on \$85,000 = 17,850 + $(85,000 - 80,000) \times \frac{38}{100}$		
Question 5 A The scrap value is \$2000 The office equipment is written off after 6 years. The rate of depreciation is the gradient of the line $\frac{2-8}{6-0} = -1$ The negative indicates depreciation. Hence depreciation is \$1,000 per year.	Question 6 D Tax payable on \$78,000 = 4,350 + $(78,000 - 35,000) \times \frac{30}{100}$ Tax payable on \$78,000 = \$17,250 Tax payable on \$85,000 = 17,850 + $(85,000 - 80,000) \times \frac{38}{100}$ Tax payable on \$85,000 = \$19,750		
Question 5 A The scrap value is \$2000 The office equipment is written off after 6 years. The rate of depreciation is the gradient of the line $\frac{2-8}{6-0} = -1$ The negative indicates depreciation. Hence depreciation is \$1,000 per year.	Question 6 D Tax payable on \$78,000 = 4,350 + $(78,000 - 35,000) \times \frac{30}{100}$ Tax payable on \$78,000 = \$17,250 Tax payable on \$85,000 = 17,850 + $(85,000 - 80,000) \times \frac{38}{100}$ Tax payable on \$85,000 = \$19,750 Difference = \$19,750 - \$17,250 = \$2,500		

Module 4 Dusiness-related mathematics			
Question 7 E	Question 8 B		
Use TVM solver	Use TVM solver		
$N = 5 \times 4 = 20$	N = ?		
I = 8	I = 6		
PV = -16000	PV = 82000		
PMT = 0	PMT = -2100		
FV = ?	FV = 0		
P / Y = 4	P / Y = 12		
C / Y = 4	C / Y = 12		
End	End		
Alpha solve gives $FV = 23775.16$	Alpha solve gives $N = 43.55$ months = 3.6 years		
Interest = $23775.16 - 16000 = 7775.16$	This is closest to 4 years		
This is closest to \$7775			
Question 9 B	N = ?		
	I = 7.5		
Use TVM solver	PV = 31080.56825		
<i>N</i> = 20	PMT = -1400		
<i>I</i> = 7.5	FV = 0		
PV = 36000	P / Y = 4		
PMT = -880	C / Y = 4		
FV = ?	End		
P / Y = 4	Alpha solve gives $N = 28.977$ quarters = 7.2 years		
C / Y = 4	Total = 7.2 + 5 = 12.2 years.		
End			
Alpha solve gives $FV = -31080.56825$			

#### Module 4 Business-related mathematics

Module 5 Networks and decision mathematics

Question 1 D	Question 2 B	
Number of vertices = 6 Number of edges = $\frac{6 \times (6-1)}{2} = 15$	A simple graph has no multiple edges or loops	
Question 3 D	Question 4 A	
For an Euler path to exist, there must be just two odd vertices. A, B and E have more than 2 odd vertices. C has 1 odd vertex	For a tree, $v = e + 1$ The number of edges is one less than the numb of vertices.	
Question 5 B	Question 6 C	
$A = \begin{bmatrix} 5 & B & 4 & E \\ 3 & 4 & 2 \\ 2 & C & 7 & D \end{bmatrix} F$	Euler's formula only applies to planar graphs. C is not planar.	
Shortest route is ACEDF = $2 + 4 + 2 + 1 = 9$ km.		
Question 7 C $A \xrightarrow{12} 6 \xrightarrow{B} 8$ $7 \xrightarrow{D} 4 \xrightarrow{C} 5 \xrightarrow{10} 7$ $D \xrightarrow{4} E$ Maximum flow = Minimum cut		
= 12 + 8 + 4 = 24		

#### Module 5 Networks and decision mathematics

#### Question 8 E

To minimize the problem take each value in the table away from the maximum value in the table, 20

	Tennis	Netball	Squash	Darts
Andy	14	10	10	13
Ben	13	16	16	12
Cathy	11	11	10	12
Demi	6	12	11	0

Reduce the rows by subtracting the smallest number in each row from each element in the row.

	Tennis	Netball	Squash	Darts
Andy	4	0	0	3
Ben	1	4	4	0
Cathy	1	1	0	2
Demi	6	12	11	0

Reduce the columns by subtracting the smallest number in each column from each element in the column.

	Tennis	Netball	Squash	Darts
Andy	3	0	0	3
Ben	0	4	4	0
Cathy	0	1	0	2
Demi	5	12	11	0

Allocate sport. Darts - Demi; Netball - Andy; Tennis - Ben; Squash - Cathy.

#### Module 5 Networks and decision mathematics

#### Question 9 B

Critical Path is **B-C-F-G-K-L** Total time before crashing = 10 + 4 + 5 + 6 + 2 + 1 = 28 days. After crashing, project becomes



Now critical path is **B-C-E-I-J-L** Total time now is 10 + 4 + 4 + 3 + 4 + 1 = 26 days. Time is reduced by 2 days.

#### **Module 6 Matrices**

Question 1 E	Question 2 C
$kA = -3 \begin{bmatrix} -1 & 2 \\ 6 & -4 \\ 0 & 3 \end{bmatrix} = \begin{bmatrix} -1 \times -3 & 2 \times -3 \\ 6 \times -3 & -4 \times -3 \\ 0 \times -3 & 3 \times -3 \end{bmatrix} = \begin{bmatrix} 3 & -6 \\ -18 & 12 \\ 0 & -9 \end{bmatrix}$	$P + Q = \begin{bmatrix} 2 & -1 & 4 \\ -3 & 3 & 6 \end{bmatrix} + \begin{bmatrix} 2 & 0 & -3 \\ 1 & 8 & 7 \end{bmatrix}$ $= \begin{bmatrix} 4 & -1 & 1 \\ -2 & 11 & 13 \end{bmatrix}$ $R = \begin{bmatrix} 8 & -1 & -2 \\ 0 & 16 & 20 \end{bmatrix} - \begin{bmatrix} 4 & -1 & 1 \\ -2 & 11 & 13 \end{bmatrix}$ $= \begin{bmatrix} 4 & 0 & -3 \\ 2 & 5 & 7 \end{bmatrix}$
Question 3 A	Question 4 C
$A^{-1} = \frac{1}{12 - 2} \begin{bmatrix} 3 & -1 \\ -2 & 4 \end{bmatrix} = \frac{1}{10} \begin{bmatrix} 3 & -1 \\ -2 & 4 \end{bmatrix}$ s = 0.4	$\begin{bmatrix} 5 & 0 \\ 0 & 5 \end{bmatrix} - \begin{bmatrix} 6.3 & -2.3 \\ 0.5 & -4.4 \end{bmatrix} = \begin{bmatrix} -1.3 & 2.3 \\ -0.5 & 9.4 \end{bmatrix}$
Question 5 D	Question 6 B
The equations can be moved into the order 1a + 0b + 0c + 1d = 5 0a + 4b + 7c + 0d = 8 3a + 2b + 0c + 0d = 6 0a + 0b + 5c + 2d = 9 This gives the matrix $\begin{bmatrix} 1 & 0 & 0 & 1 \\ 0 & 4 & 7 & 0 \\ 3 & 2 & 0 & 0 \\ 0 & 0 & 5 & 2 \end{bmatrix} \begin{bmatrix} a \\ b \\ c \\ d \end{bmatrix} = \begin{bmatrix} 5 \\ 8 \\ 6 \\ 9 \end{bmatrix}$	A singular matrix occurs when $\Delta = 0$ $\Delta = a^2 - 2ab = 0$ a(a - 2b) = 0 a = 0 or $a = 2b$

#### Module 6 Matrices

Question 7 D	Question 8 E			
To multiply matrices, the number of columns in the first matrix must equal the number of rows in the second matrix. Only <b>D</b> satisfies this requirement.	0.6 LB this year are SB next year so 0.6 goes in the first column second row. 0.4 LB this year are LB next year so this goes in the first column first row. 0.3 SB this year are LB next year, so this goes in the second column, second row. The remaining spot is for the 0.7 SB that remains.			
Question 9 B				
$2A^{3} = \left[\begin{array}{cc} 1 & 0\\ 0 & 1 \end{array}\right]$				
$2A^2 \times A = \left[\begin{array}{cc} 1 & 0\\ 0 & 1 \end{array}\right]$				
$\begin{vmatrix} 2A^2 = A^{-1} = 2 \begin{bmatrix} p & q \\ r & s \end{bmatrix} \begin{bmatrix} p & q \\ r & s \end{bmatrix} = \begin{bmatrix} 2p^2 + 2qr & 2pq + 2qs \\ 2pr + 2rs & 2qr + 2s^2 \end{bmatrix}$				

#### End of Suggested Solutions 2010 Further Mathematics VCE Trial Examination 1

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