MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2023/2024

PMT0301 – MATHEMATICS III

(for Foundation students only)

26 FEBRUARY 2024
9.00 a.m. – 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 3 printed pages excluding cover page, formula list and statistical table.

2. Answer **ALL THREE** questions.

3. All necessary working steps must be shown in the Answer Booklet provided.

QUESTION 1 **[15 Marks]**

a) Given the difference between the 5th term and 2nd term of an arithmetic sequence is -12. If the sum of the first 5 terms is 90, find the 1st term and common difference. (3 marks)

b) Find the sum of the geometric series $1 + 3 + 9 + \cdots + 729$. You need to show the working steps by using the geometric sequence formula. (2.5 marks)

c) Given $A = \begin{bmatrix} 3 & 1 & 1 \\ 0 & -2 & 3 \end{bmatrix}$, $B = \begin{bmatrix} 0 & 1 \\ 1 & 2 \\ -2 & 0 \end{bmatrix}$ and $C = \begin{bmatrix} 6 & -1 \\ 4 & 3 \end{bmatrix}$. Find $C^T + AB$. (3 marks)

d) Solve the system of linear equations with Gaussian elimination with back-substitution method. (6.5 marks)

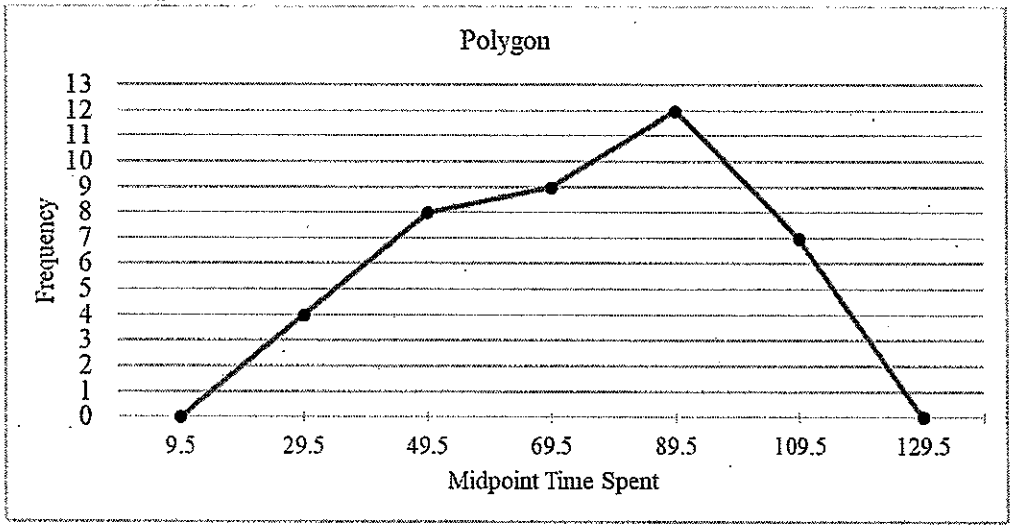
$$x + y + z = 15$$
$$2x - y + 2z = 33$$
$$2x - 3z = -18$$

QUESTION 2 **[15 Marks]**

a) Find the vector and parametric equation for a line passing through $(4,1,-4)$ and orthogonal to both $2\boldsymbol{i} - \boldsymbol{j}$ and $\boldsymbol{i} + 3\boldsymbol{j} + 2\boldsymbol{k}$. (4 marks)

b) Find an equation of the plane that contains the line $x = 2 - t$, $y = 1 + 2t$, $z = -3 + 3t$ and is parallel to the plane $x - 2y + 8z = 22$. (3 marks)

c) Below is the polygon for the time spent gaming (in minutes) during the night time by a random sample of 40 students in MMU hostel.



Calculate the mean and standard deviation. Correct your answer to 2 decimal places. (5.5 marks)

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d) Refer to the frequency distribution table given below:

Class Limit	Frequency
20 – 29	13
30 – 39	10
40 – 49	18
50 – 59	15
60 – 69	9

Calculate the mode using formula. Correct your answer to 2 decimal places.

(2.5 marks)

QUESTION 3 **[20 Marks]**

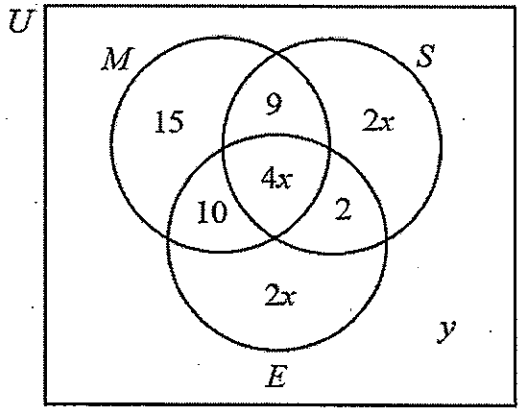
a) Suppose a department contains 15 men and 10 women. How many ways are there to form a committee with six members if it must have more men than women (the committee must consist of both gender)? (2 marks)

b) The Venn diagram below shows the number of student enrollment in one of the Tuition Centre in Cyberjaya. Given that

Set M = {students who enroll in Mathematics class}

Set S = {students who enroll in Science class}

Set E = {students who enroll in English class}



There are 110 students enroll this year. If the number of students who enroll in Science class are 53 students,

i. Find x. (1.5 marks)

ii. calculate $n(\overline{M \cup S \cup E})$. (1.5 marks)

iii. find $n\big((S \cup E) \cap M\big)$. (1 mark)

Continued...

c) A faculty has three departments, each department consist of foundation, diploma and degree students as shown in the table below:

Education	**Data science (DS)**	**Game Development (GD)**	**Information System (IS)**
Foundation	22	33	20
Diploma	30	22	45
Degree	52	38	38

If a student is selected at random from this group, find the probability that

i. the student is from GD department and is a diploma student. (1 mark)

ii. the student is from IS department, given that the student takes degree program. (2 marks)

iii. the student takes foundation program, given that the student is in DS department. (2 marks)

d) A survey reveals that 20% of students at one of the private university in Selangor have part-time jobs. A random sample of 25 students are selected.

i. Find the probability that at most 2 students have part-time jobs. (2 marks)

ii. What is the mean and standard deviation of the number of students who have part-time jobs? (2 marks)

e) On average, there are 3.5 fraud cases filed at a particular police station in a week. Given a certain week at these particular police station, compute the probability that there are more than one fraud cases filed in a week. (2 marks)

f) The intelligence quotient (IQ) test results of foundation students in a college are normally distributed with mean of 112 and a standard deviation of 8. What is the probability that a randomly selected students will have an IQ test results between 105 and 120? (3 marks)

End of Question.

APPENDIX – KEY FORMULA

Arithmetic Sequence	*Geometric Sequence*
$a_n = a_1 + (n-1)d$ $S_n = \frac{n}{2}(a_1 + a_n)$	$a_n = a_1 r^{n-1}$, $S_n = \frac{a_1(1-r^n)}{1-r}$ $S_\infty = \frac{a_1}{1-r}, \lvert r \rvert < 1$

Angle between vector
If θ is the angle between the vector $\boldsymbol{a}$ and $\boldsymbol{b}$, then $\boldsymbol{a} \cdot \boldsymbol{b} = |\boldsymbol{a}||\boldsymbol{b}| \cos\theta$

Equation of lines
Vector equation: $\boldsymbol{r} = r_0 + t\boldsymbol{v}$

Equation of planes
Vector equations: $\boldsymbol{n} \cdot (r - r_0) = 0$

Mean for grouped data	*Variance for grouped data*
$\bar{x} = \frac{\sum mf}{n}$	$s^2 = \frac{\sum m^2 f - \frac{(\sum mf)^2}{n}}{n-1}$
Median for grouped data	***Mode for grouped data***
$L + \left[\frac{\frac{\sum f}{2} - F_L}{f_m}\right] c$	$L + \left[\frac{(f_m - f_B)}{(f_m - f_B) + (f_m - f_A)}\right] c$

Addition rule
$P(A \cup B) = P(A) + P(B) - P(A \cap B)$

Conditional probability
$P(B|A) = \frac{P(B \cap A)}{P(A)}$

Binomial probability formula
$P(X = x) = \binom{n}{x} p^x q^{n-x}$

Poisson probability formula
$P(X = x) = \frac{e^{-\lambda}\lambda^x}{x!}$

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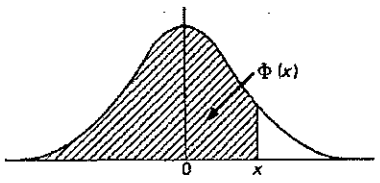
THE NORMAL DISTRIBUTION FUNCTION

The function tabulated is $\Phi(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{x} e^{-\frac{1}{2}t^2} dt$. $\Phi(x)$ is the probability that a random variable, normally distributed with zero mean and unit variance, will be less than or equal to x. When $x < 0$ use $\Phi(x) = 1 - \Phi(-x)$, as the normal distribution with zero mean and unit variance is symmetric about zero.



x	$\Phi(x)$	x	$\Phi(x)$	x	$\Phi(x)$	x	$\Phi(x)$	x	$\Phi(x)$	x	$\Phi(x)$
0·00	0·5000	0·40	0·6554	0·80	0·7881	1·20	0·8849	1·60	0·9452	2·00	0·97725
·01	·5040	·41	·6591	·81	·7910	·21	·8869	·61	·9463	·01	·97778
·02	·5080	·42	·6628	·82	·7939	·22	·8888	·62	·9474	·02	·97831
·03	·5120	·43	·6664	·83	·7967	·23	·8907	·63	·9484	·03	·97882
·04	·5160	·44	·6700	·84	·7995	·24	·8925	·64	·9495	·04	·97932
0·05	0·5199	0·45	0·6736	0·85	0·8023	1·25	0·8944	1·65	0·9505	2·05	0·97982
·06	·5239	·46	·6772	·86	·8051	·26	·8962	·66	·9515	·06	·98030
·07	·5279	·47	·6808	·87	·8078	·27	·8980	·67	·9525	·07	·98077
·08	·5319	·48	·6844	·88	·8106	·28	·8997	·68	·9535	·08	·98124
·09	·5359	·49	·6879	·89	·8133	·29	·9015	·69	·9545	·09	·98169
0·10	0·5398	0·50	0·6915	0·90	0·8159	1·30	0·9032	1·70	0·9554	2·10	0·98214
·11	·5438	·51	·6950	·91	·8186	·31	·9049	·71	·9564	·11	·98257
·12	·5478	·52	·6985	·92	·8212	·32	·9066	·72	·9573	·12	·98300
·13	·5517	·53	·7019	·93	·8238	·33	·9082	·73	·9582	·13	·98341
·14	·5557	·54	·7054	·94	·8264	·34	·9099	·74	·9591	·14	·98382
0·15	0·5596	0·55	0·7088	0·95	0·8289	1·35	0·9115	1·75	0·9599	2·15	0·98422
·16	·5636	·56	·7123	·96	·8315	·36	·9131	·76	·9608	·16	·98461
·17	·5675	·57	·7157	·97	·8340	·37	·9147	·77	·9616	·17	·98500
·18	·5714	·58	·7190	·98	·8365	·38	·9162	·78	·9625	·18	·98537
·19	·5753	·59	·7224	·99	·8389	·39	·9177	·79	·9633	·19	·98574
0·20	0·5793	0·60	0·7257	1·00	0·8413	1·40	0·9192	1·80	0·9641	2·20	0·98610
·21	·5832	·61	·7291	·01	·8438	·41	·9207	·81	·9649	·21	·98645
·22	·5871	·62	·7324	·02	·8461	·42	·9222	·82	·9656	·22	·98679
·23	·5910	·63	·7357	·03	·8485	·43	·9236	·83	·9664	·23	·98713
·24	·5948	·64	·7389	·04	·8508	·44	·9251	·84	·9671	·24	·98745
0·25	0·5987	0·65	0·7422	1·05	0·8531	1·45	0·9265	1·85	0·9678	2·25	0·98778
·26	·6026	·66	·7454	·06	·8554	·46	·9279	·86	·9686	·26	·98809
·27	·6064	·67	·7486	·07	·8577	·47	·9292	·87	·9693	·27	·98840
·28	·6103	·68	·7517	·08	·8599	·48	·9306	·88	·9699	·28	·98870
·29	·6141	·69	·7549	·09	·8621	·49	·9319	·89	·9706	·29	·98899
0·30	0·6179	0·70	0·7580	1·10	0·8643	1·50	0·9332	1·90	0·9713	2·30	0·98928
·31	·6217	·71	·7611	·11	·8665	·51	·9345	·91	·9719	·31	·98956
·32	·6255	·72	·7642	·12	·8686	·52	·9357	·92	·9726	·32	·98983
·33	·6293	·73	·7673	·13	·8708	·53	·9370	·93	·9732	·33	·99010
·34	·6331	·74	·7704	·14	·8729	·54	·9382	·94	·9738	·34	·99036
0·35	0·6368	0·75	0·7734	1·15	0·8749	1·55	0·9394	1·95	0·9744	2·35	0·99061
·36	·6406	·76	·7764	·16	·8770	·56	·9406	·96	·9750	·36	·99086
·37	·6443	·77	·7794	·17	·8790	·57	·9418	·97	·9756	·37	·99111
·38	·6480	·78	·7823	·18	·8810	·58	·9429	·98	·9761	·38	·99134
·39	·6517	·79	·7852	·19	·8830	·59	·9441	·99	·9767	·39	·99158

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x	$\Phi(x)$	x	$\Phi(x)$	x	$\Phi(x)$	x	$\Phi(x)$	x	$\Phi(x)$	x	$\Phi(x)$
2·40	0·99180	2·55	0·99461	2·70	0·99653	2·85	0·99781	3·00	0·99865	3·15	0·99918
·41	·99202	·56	·99477	·71	·99664	·86	·99788	·01	·99869	·16	·99921
·42	·99224	·57	·99492	·72	·99674	·87	·99795	·02	·99874	·17	·99924
·43	·99245	·58	·99506	·73	·99683	·88	·99801	·03	·99878	·18	·99926
·44	·99266	·59	·99520	·74	·99693	·89	·99807	·04	·99882	·19	·99929
2·45	0·99286	2·60	0·99534	2·75	0·99702	2·90	0·99813	3·05	0·99886	3·20	0·99931
·46	·99305	·61	·99547	·76	·99711	·91	·99819	·06	·99889	·21	·99934
·47	·99324	·62	·99560	·77	·99720	·92	·99825	·07	·99893	·22	·99936
·48	·99343	·63	·99573	·78	·99728	·93	·99831	·08	·99896	·23	·99938
·49	·99361	·64	·99585	·79	·99736	·94	·99836	·09	·99900	·24	·99940
2·50	0·99379	2·65	0·99598	2·80	0·99744	2·95	0·99841	3·10	0·99903	3·25	0·99942
·51	·99396	·66	·99609	·81	·99752	·96	·99846	·11	·99906	·26	·99944
·52	·99413	·67	·99621	·82	·99760	·97	·99851	·12	·99910	·27	·99946
·53	·99430	·68	·99632	·83	·99767	·98	·99856	·13	·99913	·28	·99948
·54	·99446	·69	·99643	·84	·99774	·99	·99861	·14	·99916	·29	·99950
2·55	0·99461	2·70	0·99653	2·85	0·99781	3·00	0·99865	3·15	0·99918	3·30	0·99952

The critical table below gives on the left the range of values of x for which $\Phi(x)$ takes the value on the right, correct to the last figure given; in critical cases, take the upper of the two values of $\Phi(x)$ indicated.

3·075	0·9990	3·263	0·9994	3·731	0·99990	3·916	0·99995
3·105	0·9991	3·320	0·9995	3·759	0·99991	3·976	0·99996
3·138	0·9992	3·389	0·9996	3·791	0·99992	4·055	0·99997
3·174	0·9993	3·480	0·9997	3·826	0·99993	4·173	0·99998
3·215	0·9994	3·615	0·9998	3·867	0·99994	4·417	0·99999
			0·9999		0·99995		1·00000

When $x > 3{\cdot}3$ the formula $1-\Phi(x) \doteqdot \dfrac{e^{-\frac{1}{2}x^2}}{x\sqrt{2\pi}}\left[1-\dfrac{1}{x^2}+\dfrac{3}{x^4}-\dfrac{15}{x^6}+\dfrac{105}{x^8}\right]$ is very accurate, with relative error less than $945/x^{10}$.

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