



LITTORAL MATHEMATICS TEACHERS ASSOCIATION (L.I.M.T.A)



GENERAL CERTIFICATE OF EDUCATION MOCK EXAMINATION

0775 Further Mathematics 1

APRIL 2021

ADVANCED LEVEL

CENTRE NO & NAME	Alpha Study Group
Candidate No	
Candidate Name	www.alstu.com

Mobile phones are NOT allowed in the examination room.

MULTIPLE CHOICE QUESTIONS PAPER

One and a half hours

INSTRUCTIONS TO CANDIDATES

Read the following instructions carefully before you start answering the questions in this paper. Make sure you have a soft HB pencil and an eraser for this examination.

1. USE A SOFT HB PENCIL THROUGHOUT EXAMINATION
2. DO NOT OPEN THIS QUESTION PAPER UNTIL YOU ARE TOLD TO DO SO.

Before the examination begins:

3. Check that this question booklet is headed "Advanced Level 0775 Further Mathematics 1"
4. Fill in the information required in the spaces above
5. Fill in the information required in the spaces provided on the answer sheet using your HB pencil:

Candidate Name, Exam Session, Subject Code and Candidate Identification Number.

Take care that you do not crease or fold the answer sheet or make any mark on it other than those asked for in these instructions.

How to answer questions in the examination:

6. Answer ALL questions.
7. Mathematical tables (Formulae booklets) and calculators are not allowed.
8. Each question has FOUR suggested answers: A, B, C and D. Decide on which answer is correct. Find the number of the question on the answer sheet and draw horizontal line across the letter to join the square bracket to the answer you have chosen.
For example, if C is your correct answer, mark C as shown here.
[A] [B] [~~C~~] [D]
9. Mark only one answer for each question. If you mark more than one answer you will score a zero for that question. If you change your mind about an answer, erase the first mark carefully then mark your new answer.
10. Avoid spending too much time on any one question. If you find a question difficult, move on to the next question. You can come back to this question later.
11. Do all rough work in this booklet, using, where necessary, the blank spaces in the question booklet.
12. At the end of the examination, the invigilator shall collect the answer sheet first then the question booklet. DO NOT ATTEMPT TO LEAVE THE EXAMINATION HALL WITH IT.

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1. If a , b and c are constants, then $\frac{1-x^3}{x(x-1)}$ decomposed into partial fractions yields
- [A] $1 + \frac{a}{x} + \frac{b}{x-1}$
- [B] $\frac{a}{x} - \frac{b}{x-1} - 1$
- [C] $ax + b + \frac{c}{x}$
- [D] $\frac{a}{x} + \frac{b}{x-1}$
2. For what value of k is the function $f(x) = \begin{cases} \frac{\sinh^2 x}{x^2}, & x \neq 0 \\ k, & x = 0 \end{cases}$ continuous at $x = 0$?
- [A] 0
- [B] 2
- [C] 1
- [D] $\frac{1}{2}$
3. Given the group $S = (\{a, b, c, d\}, \otimes)$
- | | | | | |
|-----------|---|---|---|---|
| $\otimes$ | a | b | c | d |
| a | c | d | a | b |
| b | d | a | b | c |
| c | a | b | c | d |
| d | b | c | d | a |
- The set of elements with self-inverse is
- [A] $\{a, c\}$
- [B] $\{a, d\}$
- [C] $\{b, c\}$
- [D] $\{b, d\}$
4. Given that the sequence a_n is convergent, then
- [A] $\lim_{n \rightarrow \infty} \frac{a_{n+1}}{a_n} = 1$
- [B] $\lim_{n \rightarrow \infty} \frac{a_{n+1}}{a_{n+2}} > 1$
- [C] $\lim_{n \rightarrow \infty} \frac{a_{n+1}}{a_n} > 1$
- [D] $\lim_{n \rightarrow \infty} \frac{a_n}{a_{n+1}} < 1$
5. Given that $I_{m,n} = \int_0^1 x^m (1-x)^n dx$, where $m, n \in \mathbb{N}$, then
- [A] $I_{m,n} = I_{n,m}$
- [B] $I_{m,n} = I_{m-1,n}$
- [C] $I_{m,n} = I_{n-1,m-1}$
- [D] $I_{m,n} = I_{m-1,n-1}$
6. The curve C has parametric equations $x = a(t - \sin t)$, $y = a(1 - \cos t)$, $a > 0$, $0 \leq t \leq 2\pi$. The mean value of y with respect to x for $0 \leq t \leq 2\pi$ is $\frac{3a^2}{2}$. Then the area of the region bounded by the curve and the x -axis is
- [A] $\frac{3\pi a^2}{2}$
- [B] $\frac{3\pi a}{2}$
- [C] $3\pi a^2$
- [D] $3\pi a$
7. $(G, \circ)$ and $(H, *)$ are groups, with group operations $\circ$ and $*$ respectively. Then a homomorphism of G into H is a map $f: G \rightarrow H$ which satisfies the condition
- [A] $f(x \circ y) = f(x) + f(y), \forall x, y \in G$
- [B] $f(x * y) = f(x) \circ f(y), \forall x, y \in G$
- [C] $f(x \circ y) = f(x) * f(y), \forall x, y \in G$
- [D] $f(x * y) = f(x \circ y), \forall x, y \in H$
8. The furthest point from the pole to the polar curve with equation $r = \frac{2}{2 + \cos \theta}$, occurs when
- [A] $\theta = \frac{\pi}{2}$
- [B] $\theta = \pi$
- [C] $\theta = 0$
- [D] $\theta = \frac{\pi}{3}$
9. The moment of inertia of an object of mass $2m$ is $4ma^2$, its radius of gyration is
- [A] $2a^2$
- [B] $2a$
- [C] $a\sqrt{2}$
- [D] $\frac{\sqrt{2}a}{2}$
10. A particle P moves on the curve with equation $r = ae^\theta$ with constant angular speed ω . The transverse component of the acceleration of P is
- [A] ωr
- [B] $2\omega^2 r$
- [C] 0
- [D] $-\omega^2 r$

11.	Given the differential equation $\frac{d^2y}{dx^2} = \left(\frac{dy}{dx}\right)^2$ and $y = 1$, $\frac{dy}{dx} = 4$ when $x = 0$. The first three non-zero terms in the Taylor's series the differential equation are: [A] $1 + 4x + 16x^2 + \dots$ [B] $1 + 4x + 8x^2 + \dots$ [C] $1 + 4x + 2x^2 + \dots$ [D] $1 + 4x + 4x^2 + \dots$	[A] 1 [B] -2 [C] -1 [D] 2
12.	The integrating factor of the differential equation $x \frac{dy}{dx} - (2-x)y = \frac{\sin x}{x}, x \neq 0$ is [A] $-\frac{1}{x^2}e^{-x}$ [B] x^2e^{-x} [C] $\frac{1}{x^2}e^x$ [D] x^2e^x	17. $\int_0^{\ln 2} e^{\sinh x} \cosh x dx =$ [A] $e^{\frac{1}{4}} - 1$ [B] $e^{\frac{3}{2}} - 1$ [C] $e^{\frac{3}{4}} - 1$ [D] $1 - e^{\frac{5}{4}}$
13.	The image of the vector $\mathbf{i} + \mathbf{j}$ under the linear transformation with matrix $\mathbf{M}$, where $\mathbf{M} = \begin{pmatrix} 1 & 2 & -1 \\ 0 & 1 & 1 \\ 1 & 1 & -2 \end{pmatrix}$ is [A] $\mathbf{i} + 2\mathbf{j} + 3\mathbf{k}$ [B] $\mathbf{i} + \mathbf{j}$ [C] $2\mathbf{i} + \mathbf{j} + 2\mathbf{k}$ [D] $3\mathbf{i} + \mathbf{j} + 2\mathbf{k}$	18. The vertex of the of the parabola with equation $y = 2 x - x x $, is $x < 0$ [A] (1,0) [B] (-1,1) [C] (1,-1) [D] (0,-1)
14.	The equation of the axis of symmetry to the curve of $f(x) = \frac{4}{4-x^2}$ is [A] $x = 2$ [B] $y = 0$ [C] $x = 0$ [D] $x = -2$	19. Given that the random variable Z follows a standard normal distribution, then $P(Z < -a) =$ [A] $1 - P(Z < a)$ [B] $2P(Z < a) - 1$ [C] $P(Z < a) - 1$ [D] $P(Z < a)$
15.	When two moving spheres collide obliquely, which of the following statements is not true? [A] Equal and opposite impulse act on them [B] There is a loss in the total kinetic energy of the spheres [C] They move in opposite direction after impact [D] Their velocities perpendicular to the line of action do not change	20. How many distinct solutions are there to the congruence $2x \equiv 15 \pmod{21}$ [A] 1 [B] 2 [C] 3 [D] 4
16.	The general solution to the differential equation $\frac{d^2y}{dx^2} + a \frac{dy}{dx} - 2y = 0$ is $y = Ae^{-2x} + Be^x$. The value of a is	21. A particle moves along a straight line OX such that its displacement x from O at time t is given by the equation $\frac{d^2x}{dt^2} - \frac{dx}{dt} + 3x = 0$, the period of the motion is [A] $\frac{2\pi}{3}$ [B] $\frac{\pi}{3}$ [C] $\frac{\pi}{2}$ [D] $\frac{3\pi}{2}$

22. The moment of inertia of a uniform disc of mass m and radius $2a$ about an axis through its center and perpendicular to the plane is $2ma^2$. The moment of inertia of the disc about a tangent line in the plane of the disc is

[A] $2ma^2$
 [B] $5ma^2$
 [C] ma^2
 [D] $3ma^2$

23. Given the complex number $z = (-1+i)^2 e^{-\ln \theta}$ then $\arg z =$

[A] $-\frac{\pi}{2} + n\theta$
 [B] $\frac{3\pi}{2} - n\theta$
 [C] $\frac{3\pi}{4} + n\theta$
 [D] $-\frac{3\pi}{4} - n\theta$

24. The value of the constant k for which

$$P(x) = \begin{cases} k(2-x), & x = 0, 1, 2 \\ 0, & \text{otherwise} \end{cases}$$

is a probability mass function is

[A] $\frac{1}{4}$
 [B] $\frac{1}{2}$
 [C] $\frac{1}{6}$
 [D] $\frac{1}{3}$

25. Given that $\mathbf{N} = \begin{pmatrix} 1 & 2 & 3 \\ 3 & 2 & 1 \end{pmatrix}$ and $\mathbf{M} = \begin{pmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \end{pmatrix}$ are elements of S_3 , the symmetric group of permutations of $A = \{1, 2, 3\}$, then the composition $\mathbf{M} \circ \mathbf{N}$ is

[A] $\begin{pmatrix} 1 & 2 & 3 \\ 6 & 2 & 3 \end{pmatrix}$
 [B] $\begin{pmatrix} 1 & 2 & 3 \\ 2 & 1 & 3 \end{pmatrix}$
 [C] $\begin{pmatrix} 1 & 2 & 3 \\ 3 & 2 & 1 \end{pmatrix}$
 [D] $\begin{pmatrix} 1 & 2 & 3 \\ 1 & 3 & 2 \end{pmatrix}$

26. The polar equation of curve with Cartesian equation $y = x^2$ is

[A] $r \tan \theta \sec \theta = 0$
 [B] $r = \tan^2 \theta \sec \theta$
 [C] $r \tan \theta = \sec \theta$
 [D] $r = \tan \theta \sec \theta$

27. Given that the power series for $\cos x^2$ is $1 - \frac{x^4}{2!} + \frac{x^8}{4!} - \dots$, which of the following could be the general term for the series?

[A] $\frac{(-1)^{r+1} x^{2r}}{(2r)!}$
 [B] $\frac{(-1)^r x^{2r+2}}{(2r)!}$
 [C] $\frac{(-1)^r x^{4r}}{(2r)!}$
 [D] $\frac{(-1)^{r+1} x^{2r+2}}{(2r)!}$

28. The value of x for which $\cosh^{-1}(2x) = \ln 4$ is:

[A] $\frac{17}{16}$
 [B] $\frac{15}{8}$
 [C] $\frac{15}{16}$
 [D] $\frac{17}{8}$

29. The value(s) of n for which the complex number $z = (1 + \sqrt{3}i)^n$ is purely real are _____, for all integers k .

[A] $n = 3k + 1$
 [B] $n = 3k + 2$
 [C] $n = 3k$
 [D] $n = 2k + 3$

30. Figure 1 shows a cube with sides 2 units. The coordinates of the point Q is

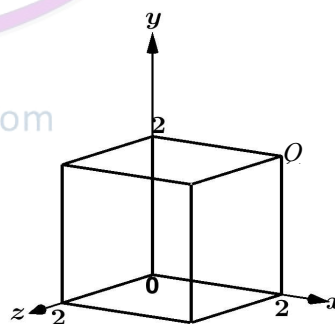


Figure 1

[A] $(0, 2, 0)$
 [B] $(2, 2, 0)$
 [C] $(0, 2, 2)$
 [D] $(2, 0, 2)$

31. Given that S is a similitude defined by $z' = (1+i)z + 2+i$, the affix centre of the similitude is:
- [A] $1-2i$
 [B] $-1+2i$
 [C] $2-i$
 [D] $-1-2i$

32. The maximum value of $\frac{8}{3 \cosh(\ln x) + 1}$ for all $x > 0$ is
- [A] $\frac{1}{2}$
 [B] 2
 [C] 1
 [D] 8

33. The equation $\frac{x^2}{2-a} + \frac{y^2}{a-5} = -1$ represents an ellipse if
- [A] $a > 2$
 [B] $a > 5$
 [C] $2 < a < 5$
 [D] $a = 1$

34. Which of the following propositions is equivalent to $\sim p \Rightarrow q$?
- [A] $p \wedge \sim q$
 [B] $p \vee q$
 [C] $\sim q \Rightarrow p$
 [D] $p \Rightarrow \sim q$

35. A smooth sphere A of mass $2m$ moving with velocity $(-3\mathbf{i} + 12\mathbf{j})\text{ms}^{-1}$ is struck so that it now moves with a velocity of $6\mathbf{i}$, the impulse exerted to A is
- [A] $6m(3\mathbf{i} - 4\mathbf{j})\text{kgms}^{-1}$
 [B] $6m(3\mathbf{i} + 4\mathbf{j})\text{kgms}^{-1}$
 [C] $6m(-3\mathbf{i} - 4\mathbf{j})\text{kgms}^{-1}$
 [D] $6m(-3\mathbf{i} + 4\mathbf{j})\text{kgms}^{-1}$

36. The value of λ for which the vectors $(1, -1, 0)$, $(0, -1, 1)$ and $(0, -1, \lambda)$ are linearly dependent is
- [A] $\lambda \neq 1$
 [B] $\lambda = -1$
 [C] $\lambda = 1$
 [D] $\lambda \neq -1$

37. A continuous random variable X has probability density function
- $$f(x) = \begin{cases} x(4 + \mu x^2), & 0 \leq x \leq 4 \\ 0, & \text{otherwise} \end{cases}$$

Given that the mode of X is $\frac{8}{3}$, then the value of the constant μ is

- [A] $-\frac{1}{2}$
 [B] $\frac{3}{2}$
 [C] -2
 [D] 3

38. A piece of land lies between a straight fence and a river at a distance x meters from one end of the fence. The width of the land, y meters was measured as follows.

x	0	20	40	60	80	100	120
y	0	22	41	53	39	17	0

Using Simpson's rule, the area of the plot is

- [A] 158m^2
 [B] 1056m^2
 [C] 3520m^2
 [D] 3360m^2

39. Which of the following motions is not harmonic?

- [A] $\ddot{x} + 9x = 0$
 [B] $\ddot{x} + \dot{x} + 4 = 0$
 [C] $\ddot{x} - \dot{x} + 3x = 0$
 [D] $\ddot{x} + 3\dot{x} + 4x = 0$

40. The value of the constant a for which the line $y = x - 2$ is an oblique asymptote to the curve $y = \frac{x^2 - ax}{x - 1}$ is

- [A] 1
 [B] 3
 [C] -1
 [D] 2

41. A particle is moving round the polar curve $r = 1 + \sin \theta$ with constant angular velocity ω . The maximum speed of the particle is

- [A] ω
 [B] $\omega\sqrt{2}$
 [C] 2ω
 [D] $\frac{\omega}{2}$

42. If x is the displacement of a particle from a fixed point O at time t , then equation of motion is given by $\frac{d^2x}{dt^2} + 4\frac{dx}{dt} + 5x = 0$. Given that the motion is damped harmonic then the damping factor is:
- [A] Ae^{-2t}
 [B] Ae^{2t}
 [C] Ae^t
 [D] Ae^{-t}
43. Given the sequence (u_n) defined by $\begin{cases} u_0 = 0 \\ u_{n+1} = \sqrt{u_n + 2}, \forall n \geq 0 \end{cases}$. Then (u_n) is
- [A] divergent
 [B] decreasing
 [C] convergent
 [D] constant
44. A particle of mass m is projected vertically upwards against a resistance of magnitude kv , where v is the velocity and k is a positive constant. Equation of motion is given by:
- [A] $\frac{dv}{dt} + kv = 0$
 [B] $m\frac{dv}{dt} - mg + kv = 0$
 [C] $m\frac{dv}{dt} - mg - kv = 0$
 [D] $m\frac{dv}{dt} + mg + kv = 0$
45. If the system of forces $\mathbf{F}_1, \mathbf{F}_2, \mathbf{F}_3 \dots$ acting through $\mathbf{r}_1, \mathbf{r}_2, \mathbf{r}_3 \dots$ respectively is in equilibrium it is necessary to show that
- [A] both $\sum \mathbf{F} = 0$ and $\sum \mathbf{r} \times \mathbf{F} = 0$
 [B] both $\sum \mathbf{F}_i = 0$ and $\sum \mathbf{r}_i \times \mathbf{F}_i \neq 0$
 [C] both $\sum \mathbf{F}_i \neq 0$ and $\sum \mathbf{r} \times \mathbf{F} = 0$
 [D] both $\sum \mathbf{F}_i \neq 0$ and $\sum \mathbf{r}_i \times \mathbf{F}_i \neq 0$
46. The value of x for which the equation $247^{349} \equiv x \pmod{7}$ is satisfied is
- [A] 1
 [B] 5
 [C] 2
 [D] 3
47. The rate of decay of a certain substance is proportional to the amount present at any time t with decay constant λ . The time taken for the amount of substance to drop to $\frac{1}{e}$ of its original value is
- [A] $\lambda \ln 2$
 [B] $\frac{1}{\lambda}$
 [C] $-\lambda \ln 2$
 [D] $\frac{1}{\lambda} \ln 2$
48. As $x \rightarrow \infty$, $\sinh x \approx$
- [A] $\sin x$
 [B] $-\sinh x$
 [C] $\tanh x$
 [D] $\cosh x$
49. A, B, C are vertices of a triangle. The area of $\triangle ABC$ is
- [A] $\frac{1}{2} |A \times B \times C|$
 [B] $\frac{1}{2} |AB \times AC|$
 [C] $|AB \times AC|$
 [D] $\frac{1}{2} |AB \cdot AC|$
50. The work done by a force $\mathbf{F} = (10\mathbf{i} - 3\mathbf{j} + 6\mathbf{k}) N$ in moving a particle from the point $A(0, 2, 5)$ to the point $B(4, -1, 1)$ is
- [A] 73J
 [B] $(40\mathbf{i} + 9\mathbf{j} + 24\mathbf{k})J$
 [C] 25J
 [D] $(40\mathbf{i} + 9\mathbf{j} - 24\mathbf{k})J$

END!

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