Mock Test-2
For Lecturer (Mathematics)

Name ...... An effort by: *Akhtar Abbas*

1. If $x^y = e^{x-y}$, then $\frac{dy}{dx}$ equals:

   A. $\frac{lnx}{1+lnx}$ B. $\frac{lnx}{(1+lnx)^2}$ C. $\frac{1+lnx}{lnx}$ D. $\frac{(1+lnx)^2}{lnx}$

2. $\lim_{x\to 0}(cotx)^{sinx}$ equals:

   A. 0 B. -1 C. 1 D. e

3. If a function f satisfies all axioms of Mean Value Theorem on $[a,b]$ and $|f'(x)| \le M$ for all $x \in [a,b]$, then:

   A. $|f(b)-f(a)| \le M(a-b)$ B. $|f(b)-f(a)| \ge M(a-b)$ C. $|f(b)-f(a)| \le M(b-a)$ D. $|f(a)-f(b)| \ge M(b-a)$

4. $\int \frac{dx}{x\sqrt{a^2+x^2}}$ equals:

   A. $\frac{1}{a}sinh^{-1}(x)$ B. $\frac{1}{a}sinh^{-1}(\frac{-a}{x})$ C. $-\frac{1}{a}sinh^{-1}(x)$ D. $-\frac{1}{a}sinh^{-1}(\frac{a}{x})$

5. The maximum error formula in Simpson's rule is $Error \le \frac{M(b-a)^5}{180n^4}$, where M equals:

   A. $|f'(x)|$ B. $|f''(x)|$ C. $|f'''(x)|$ D. $|f^{(4)}(x)|$

6. For $a>0$, $r = asin\theta$ represents a circle of radius:

   A. $\frac{a}{2}$ B. a C. $2a$ D. a^2

7. Distance of the point $(3,-1,2)$ from the plane $2x+y-z=0$ is:

   A. $\frac{3}{2}$ B. $\frac{4}{\sqrt{6}}$ C. $\frac{6}{2}$ D. $\frac{\sqrt{6}}{4}$

8. The acute angle between the planes $2x+y-z=5$ and $x-y-2z=-5$ is:

   A. $\frac{\pi}{2}$ B. $\frac{\pi}{3}$ C. $\frac{\pi}{4}$ D. $\frac{\pi}{6}$

9. The function $f(x,y,z) = \frac{\sqrt{x}+\sqrt{y}+\sqrt{z}}{x+y}$ is homogeneous of degree:

   A. $\frac{1}{2}$ B. 2 C. $-\frac{1}{2}$ D. none of these

10. If D is the region in the first quadrant between the circles $x^2+y^2=a^2$ and $x^2+y^2=b^2$, $(0<a<b)$, then $\int\int_D \frac{dxdy}{x^2+y^2}$ equals:

    A. $\frac{\pi}{lnb}$ B. $\frac{\pi}{2}ln(b)$ C. $\frac{\pi}{2}ln(a)$ D. $\frac{\pi}{2}ln(\frac{b}{a})$

11. The order of the differential equation $\frac{d^2y}{dx^2}+5x(\frac{dy}{dx})^3-4y+e^x=0$ is:

    A. 0 B. 1 C. 2 D. 3

12. Which of the following is a non-linear differential equation?

    A. $(1-x)y'+2y=e^x$ B. $y''+siny=0$ C. $y'''+y=0$ D. $y''+(sinx)y=5$

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13. The differential equation $N(x,y)dx + M(x,y)dy = 0$ is exact if:

    A. $\frac{\partial M}{\partial x} = \frac{\partial N}{\partial y}$ B. $\frac{\partial M}{\partial y} = \frac{\partial N}{\partial x}$ C. Both (A) and (B) D. None of these

14. The Wronskian $W(e^{3x}, e^{-3x})$ equals:

    A. 0 B. 6 C. -6 D. $1/6$

15. If L^{-1} is the inverse Laplace transform, then $L^{-1}(\frac{t}{t^2+k^2})$ equals:

    A. $sinks$ B. $cosks$ C. e^s D. $log(s)$

16. For a scalar point function ψ, $\nabla \times (\nabla\psi)$ equals:

    A. 0 B. ψ C. ψ^2 D. $\psi/2$

17. For a vector point function A, $\nabla(\nabla \cdot A) - \nabla^2 A$ equals:

    A. $\nabla(\nabla \cdot A)$ B. $\nabla \times (\nabla \times A)$ C. $\nabla\ (A \cdot \nabla)$ D. $\nabla \cdot (\nabla \times A)$

18. The volume of a tetrahedron with sides $\vec{a}, \vec{b}, \vec{c}$ is:

    A. $\frac{1}{2}|\vec{a} \times \vec{b} \cdot \vec{c}|$ B. $\frac{1}{6}|\vec{a} \times \vec{b} \cdot \vec{c}|$ C. $\frac{1}{2}|\vec{a} \times \vec{c} \cdot \vec{b}|$ D. $\frac{1}{2}|\vec{c} \times \vec{b} \cdot \vec{a}|$

19. For vectors $\vec{a}, \vec{b}$ and $\vec{c}$, which of the following is true?

    A. $\vec{a} \times (\vec{b} \times \vec{c}) = (\vec{a} \times \vec{b}) \times \vec{c}$ B. $\vec{a} \times \vec{b} = \vec{a} \times \vec{c}$ implies $\vec{b} = \vec{c}$ C. $\vec{a} \cdot \vec{b} = \vec{a} \cdot \vec{c}$ implies $\vec{b} = \vec{c}$
    D. None of these

20. If $\frac{d\vec{r}(t)}{dt} = 0$ on an interval $[a,b]$, then $\vec{r}(t)$ is ... on $[a,b]$.

    A. $constant$ B. $zero$ C. 1 D. $smooth$

21. If $\vec{t}, \vec{n}$ and $\vec{b}$ are tangent, normal and bi-normal vectors respectively, then for what value of X, $\begin{bmatrix} \vec{t}' \\ \vec{n}' \\ \vec{b}' \end{bmatrix} = X \begin{bmatrix} \vec{t} \\ \vec{n} \\ \vec{b} \end{bmatrix}$?

    A. $X = \begin{bmatrix} 0 & \kappa & 0 \\ \kappa & 0 & -\tau \\ 0 & \tau & 0 \end{bmatrix}$ B. $X = \begin{bmatrix} 0 & -\kappa & 0 \\ -\kappa & 0 & -\tau \\ 0 & \tau & 0 \end{bmatrix}$ C. $X = \begin{bmatrix} 0 & \kappa & 0 \\ -\kappa & 0 & -\tau \\ 0 & -\tau & 0 \end{bmatrix}$ D. $X = \begin{bmatrix} 0 & \kappa & 0 \\ -\kappa & 0 & \tau \\ 0 & -\tau & 0 \end{bmatrix}$

22. The osculating plane to a curve is parallel to:

    A. $\vec{t}$ and $\vec{n}$ B. $\vec{n}$ and $\vec{b}$ C. $\vec{b}$ only D. $\vec{n}$ only

23. If for a curve, $\frac{\kappa}{\tau}$ is a constant, then curve is a:

    A. plane curve B. space curve C. helix D. straight line

24. The rotation index of a simple closed curve is:

    A. 0 B. 1 C. -1 D. ± 1

25. For any two sets A and B, $n(A - B)$ equals:

    A. $n(A) - n(A \cap B)$ B. $n(A) - n(A \cup B)$ C. $n(B) - n(A \cap B)$ D. $n(B) - n(A \cup B)$

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26. Let R be a relation on a set A with n elements, then $R^1 \cup R^2 \cup ... \cup R^N$ is ... closure of R.

A. reflexive B. symmetric C. transitive D. skew-symmetric

27. A proper subset of a countable set is:

A. finite B. co-finite C. infinite D. countable

28. If for any two functions f and g, $g \circ f$ is onto, then:

A. g is one-one B. g is onto C. f is one-one D. f in onto

29. The set $\{x \in \mathbb{Q} : x > 0 \; and \; 2 < x^2 < 3\}$ has:

A. no supremum B. no infimum C. Both A and B D. None of these

30. The smallest positive divisor $d > 1$ of an integer n is:

A. prime B. composite C. coprime D. even

31. When 5^{48} is divided by 12, the remainder is:

A. 0 B. 1 C. 5 D. 10

32. When $1! + 2! + 3! + ... + 899!$ is divided by 3, then the remainder is:

A. 0 B. 1 C. 2 D. None of these

33. If for any integers a, b, c, m and $k > 1$, $a^k \equiv b^k (mod\ m)$, then which of the following is not true in general?

A. $a^k + c \equiv b^k + c(mod\ m)$ B. $a^k c \equiv b^k c(mod\ m)$ C. $a \equiv b(mod\ m)$ D. $b^k \equiv a^k(mod\ m)$

34. Any two Sylow p-subgroups of a group G are:

A. commutative B. finite C. conjugate D. normal

35. For $n \geq 3$, A_n is generated by:

A. 2-cycles B. 3-cycles C. 4-cycles D. None of these

36. The order of an element $\frac{p}{q} + \mathbb{Z}$ in the group $\frac{\mathbb{Q}}{\mathbb{Z}}$ is:

A. p B. q C. infinite D. 1

37. How many subgroups does the group $\mathbb{Z}_3 + \mathbb{Z}_{16}$ have?

A. 6 B. 10 C. 12 D. 24

38. The rank of an $m \times n$ matrix is:

A. m B. n C. $min(m, n)$ D. $\leq min(m, n)$

39. Suppose the system $AX = 0$ has 20 unknowns and its solution space is spanned by 6 linearly independent vectors, then which of following can't be the order of A?

A. 15×20 B. 6×20 C. 14×20 D. 16×20

40. Suppose that a linear transformation $T : \mathbb{R}^4 \to \mathbb{R}^3$ has kernel spanned by one nonzero vector. Then what is the dimension of range of T?

A. 0 B. 1 C. 2 D. 3

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41. The linear transformation $T : \mathbb{R}^2 \to \mathbb{R}^2$, $T(x, y) = (x - y, x + 2y)$ is:

    A. one-one B. onto C. bijective D. None of these

42. For what value of k, the roots of the equation $x^3 - 6x^2 + kx + 64 = 0$ are in geometric progression?

    A. -10 B. -18 C. -24 D. 12

43. If $f(1) = 2$ and $f(n-1) = f(n) - \frac{1}{2}$ for all integers $n > 1$, then $f(101)$ equals:

    A. 49 B. 50 C. 51 D. 52

44. If $|S| = n$, then the number of one-one functions from S onto S is:

    A. $n!$ B. n^2 C. n^n D. 2^n

45. If V_1 and V_2 are 6 dimensional subspaces of a 10 vector space V, what is the smallest possible dimension that $V_1 \cap V_2$ can have?

    A. 1 B. 2 C. 3 D. 4

46. A fair coin is tossed 8 times. What is the probability that more of the tosses will results in heads than will results in tails?

    A. $\frac{93}{256}$ B. $\frac{23}{64}$ C. $\frac{1}{3}$ D. $\frac{1}{4}$

47. For every set S and every metric d on S, which of the following is a metric on S?

    A. $4 + d$ B. $e^d - 1$ C. $d - \sqrt{d}$ D. $\sqrt{d}$

48. If $f(z)$ is an analytic function that maps the entire plane into the real axis, then the imaginary axis must be mapped onto:

    A. the entire real axis B. a point C. a ray D. the empty set

49. Let $I \neq A \neq -I$, where I is the identity matrix. If $A = A^{-1}$, then the trace of A is:

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

50. For a positive integer m, $\Gamma(m+1)$ equals:

    A. $m + 1$ B. m C. $(m+1)!$ D. $m!$

Best of Luck.

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