D 92460–A (Pages : 6) Name..

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FIFTH SEMESTER U.G. DEGREE (SPECIAL) EXAMINATION NOVEMBER 2020

(CUCBCSS—UG)

Mathematics

MAT 5B 08—DIFFERENTIAL EQUATIONS

(Multiple Choice Questions for SDE Candidates)

Time : 15 Minutes	Total No. of Questions : 20	Maximum : 20 Marks

INSTRUCTIONS TO THE CANDIDATE

1. This Question Paper carries Multiple Choice Questions from 1 to 20.
2. The candidate should check that the question paper supplied to him/her contains all the 20 questions in serial order.
3. Each question is provided with choices (A), (B), (C) and (D) having one correct answer. Choose the correct answer and enter it in the main answer-book.
4. The MCQ question paper will be supplied after the completion of the descriptive examination.

MAT 5B 08—DIFFERENTIAL EQUATIONS

(Multiple Choice Questions for SDE Candidates)

1. Which of the following is a linear differential equation ?

   (A) $y'' + (y')^2 = \sin x$.
   (B) $(y'')^2 + 3y = e^x$.
   (C) $y'' + 3y' + y = 0$.
   (D) $(y'')^2 + (y')^3 + e^x = 0$.

2. Which of the following is a separable differential equation ?

   (A) $\frac{dy}{dx} = \frac{x^2}{1 - y^2}$.
   (B) $\frac{dy}{dx} = \frac{x + y}{x - y}$.
   (C) $\frac{dy}{dx} + (\sin x) y = e^x$.
   (D) $\left(\frac{dy}{dx}\right)^2 + (\sin x) y = 0$.

3. The general solution of the differential equation $2x\left(3x + y - ye^{-x^2}\right)dx + \left(x^2 + 3y^2 + e^{-x^2}\right)dy = 0$ is :

   (A) $x^2 y + ye^{-x^2} + 2x^3 + y^3 = C$.
   (B) $x^2 y^2 + ye^{x^2} + 2x + y^2 = C$.
   (C) $xy + ye^{-x^2} + y^2 = C$.
   (D) $xy^2 + y + 2x^3 e^{-x^2} + y^3 = C$.

4. Which of the following is an initial value problem ?

   (A) $y' + y = 0, y(0) = y'(0) = 0$.
   (B) $y' + y = 0, y(0) = y(1) = 0$.
   (C) $y'' + y = 0, y(0) = 0, y(1) = 1$..
   (D) $y''' + y = 0, y(0) = 0, y(2) = 4$.

5. Which of the following is a boundary value problem :

   (A) $y' + y = 0, y(0) = 1, y'(0) = 0$.
   (B) $y'' + 5y = 0, y(0) = 1, y'(0) = 3$.
   (C) $x^2 y'' + xy' + y = 0, y(0) = 0, y(1) = 2$.
   (D) $y''' + y'' + y = 0, y(0) = y'(0) = y''(0) = 0$.

6. The general solution of the differential equation $y' = \cos x$ is :

(A) $y = \sin x$.
(B) $y = \cos x$.
(C) $y = C \sin x$.
(D) $y = \sin(x) + C$.

7. If $\frac{1}{N}\left(\frac{\partial M}{\partial y} - \frac{\partial N}{\partial x}\right)$ is a function of x only, then an integrating factor of $Mdx + Ndy = 0$ is :

(A) $\mu(x) = \exp\left[\int \frac{1}{N}\left(\frac{\partial M}{\partial y} - \frac{\partial N}{\partial x}\right) dx\right]$.
(B) $\mu(x) = \exp\left[\int \frac{1}{N}\left(\frac{\partial M}{\partial y} + \frac{\partial N}{\partial x}\right) dx\right]$.
(C) $\mu(x) = \int \frac{1}{N}\left(\frac{\partial M}{\partial y} - \frac{\partial N}{\partial x}\right) dx$.
(D) $\mu(x) = \int \frac{1}{N}\left(\frac{\partial M}{\partial x} - \frac{\partial N}{\partial y}\right) dx$.

8. If $\frac{1}{M}\left(\frac{\partial N}{\partial x} - \frac{\partial M}{\partial y}\right)$ is a function of y only, then an integrating factor of the differential equation $Mdx + Ndy = 0$ is :

(A) $\mu(x) = \exp\left[\int \frac{1}{M}\left(\frac{\partial N}{\partial x} - \frac{\partial M}{\partial y}\right) dy\right]$.
(B) $\mu(x) = \exp\left[\int \frac{1}{M}\left(\frac{\partial N}{\partial x} + \frac{\partial M}{\partial y}\right) dy\right]$.
(C) $\mu(x) = \int \frac{1}{M}\left(\frac{\partial N}{\partial x} - \frac{\partial M}{\partial y}\right) dy$.
(D) $\mu(x) = \int \frac{1}{M}\left(\frac{\partial N}{\partial x} + \frac{\partial M}{\partial y}\right) dy$.

9. An integrating factor of the differential equation $\frac{dx}{dy} + P(x) = Q(x)$ is :

(A) $e^{\int p dx}$.
(B) $e^{-\int p dx}$.
(C) $e^{\int p^2 dx}$.
(D) $e^{\int (P+Q) dx}$.

Turn over

10. A mathematical model of an object falling in the atmosphere near the surface of earth is given by :

(A) $m\frac{dv}{dt} = mg - rv.$ (B) $m\frac{d^2v}{dt^2} = mg - rv.$

(C) $\frac{dv}{dt} = mg.$ (D) None of these.

11. The differential equation $y'' - 5y' + 6y = 0$ has :

(A) Two linearly independent solutions.

(B) Three linearly independent solutions.

(C) Four linearly independent solutions.

(D) Infinite number of linearly independent solution.

12. The general solution of the differential equation $(D^2 - 4D + 4)y = 0$ is :

(A) $(c_0 + c_1x)e^{2x}.$ (B) $(c_0 - c_1x)e^{2x}.$

(C) $c_1e^x c_2e^{-2x}.$ (D) $c_1e^{2x} + c_2e^{2x}.$

13. The characteristic roots of the differential equation $(D^2 - 2D)y = 4x^2 + 2x + 3$ are :

(A) $\lambda = 0, \lambda = -2.$ (B) $\lambda = 1, \lambda = 3.$

(C) $\lambda = 0, \lambda = 2.$ (D) $\lambda = 1, \lambda = -2.$

14. The Laplace transform of the unit step function $u_{(t-a)}$ is :

(A) $e^{-as}.$ (B) $e^{-as}/s.$

(C) $e^{as}/s.$ (D) $e^{-as}/s^2.$

15. If $\mathcal{L}\{f(t)\} = F(s)$, then $\mathcal{L}\{f(at)\} =$

(A) $\frac{1}{a} F(s/a)$.

(B) $F(s/a)$.

(C) $F(a/s)$.

(D) $F(s)$.

16. $\int_0^\infty \frac{\sin t}{t}\, dt =$

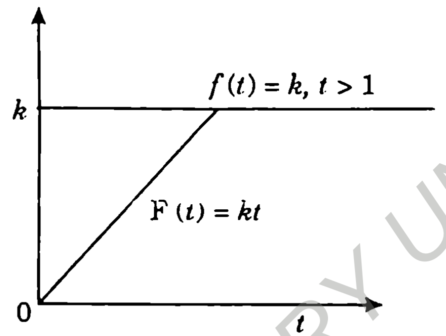
(A) $\frac{\pi}{4}$.

(B) $\frac{\pi}{8}$.

(C) $\frac{\pi}{2}$.

(D) None of these.

17. The Laplace transform of the function whose graph shown below is :



(A) $\frac{k}{s^2}\left(1-e^{-s}\right)$.

(B) $\frac{k}{s}\left(1-e^{-s}\right)$.

(C) $\frac{1}{s}\left(1-e^{-s}\right)$.

(D) None of these.

18. $\mathcal{L}\{\sin hat\} =$

(A) $\frac{a}{s^2-a^2}$.

(B) $\frac{a}{s^2+a^2}$.

(C) $\frac{s}{s^2-a^2}$.

(D) $\frac{s}{s^2+a^2}$.

19. $\mathcal{L}\{t^n\} =$

(A) $\frac{n!}{s^n}$.

(B) $\frac{(n+1)!}{s^n}$.

(C) $\frac{n!}{s^n + 1}$.

(D) $\frac{1}{s^n}$.

20. The solution to the problem :

$$\alpha^2 u_{xx} = u_{tt}, 0 \le x \le L$$

$$\begin{cases} u(0,t) = 0 \\ u(L,t) = 0 \end{cases} \qquad \begin{cases} u(x,0) = f(x) \\ u_t(x,0) = 0 \end{cases}$$ is given by

(A) $u(x,t) = \sum_{n=1}^{\infty} a_n \sin\left(\frac{n\pi x}{L}\right)\cos\left(\frac{n\pi t}{L}\right)$.

(B) $u(x,t) = \sum_{n=1}^{\infty} a_n \sin\left(\frac{n\pi t}{L}\right)\cos\left(\frac{n\pi x}{L}\right)$.

(C) $u(x,t) = \sum_{n=1}^{\infty} a_n \sin\left(\frac{n\pi x}{L}\right)$.

(D) $u(x,t) = \sum_{n=1}^{\infty} b_n \cos\left(\frac{n\pi x}{L}\right)$.

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FIFTH SEMESTER U.G. (CUCBCSS—UG) DEGREE [SPECIAL] EXAMINATION, NOVEMBER 2020

Mathematics

MAT 5B 07—BASIC MATHEMATICAL ANALYSIS

(Multiple Choice Questions for SDE Candidates)

Time : 15 Minutes	Total No. of Questions : 20	Maximum : 20 Marks

INSTRUCTIONS TO THE CANDIDATE

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MAT 5B 07—BASIC MATHEMATICAL ANALYSIS

(Multiple Choice Questions for SDE Candidates)

1. If $A_n = \{n, n+1, n+2, \ldots\ldots\}$, then, $\bigcap_{n=1}^{\infty} A_n = \ldots\ldots$

   (A) 1. (B) $\emptyset$.

   (C) ∞. (D) n.

2. If A = {1, 2, 3} and B = {4, 5} which of the following is not a member of A × B.

   (A) (1,4). (B) (2, 5).

   (C) (3, 4). (D) (4, 3).

3. Which of the following subset of A × A defines a function on $A = \{x \in \mathbb{R} : -1 \leq x \leq 1\}$.

   (A) $C = \{(x, y) : x^2 + y^2 = 1\}$. (B) $C = \{(x, y) : x + y^2 = 1\}$.

   (C) $C = \{(x, y) : x^2 + y = 1\}$. (D) None of these.

4. Which of the following set is *not* countable ?

   (A) $\{1, 2, \ldots\ldots, n\}$. (B) The set $\mathbb{N}$ of natural numbers.

   (C) The set $\mathbb{Q}$ of rational numbers. (D) The interval (0, 1).

5. The number of injections from $S = \{1, 2\}$ to $T = \{a, b, c\}$ is ———.

   (A) 2. (B) 4.

   (C) 6. (D) 8.

6. If $a \in \mathbb{R}$ such that, $0 \leq a < \varepsilon$ for every $\varepsilon > 0$ then, :

   (A) $a > 0$. (B) $a \neq 0$.

   (C) $a = 0$. (D) None of these.

7. The binary representation of 3/8 is, :

   (A) 0.0111111.... (B) 0.0101000.....

   (C) 0.1011111.... (D) 0.0101111.....

8. If $0 < b < 1$, lim (b^n) equal to :

   (A) 0. (B) 1.

   (C) b. (D) ∞.

9. Limit of the sequence $\left(\frac{3n+2}{2n+1}\right)$ is ———.

   (A) 3. (B) 1/2.

   (C) 2. (D) 3/2.

10. The smallest value of K (ε) corresponding to ε = .01 for the sequence $\left(\frac{1}{n}\right)$ is ———.

(A) 10. (B) 50.

(C) 100. (D) 101.

11. Which of the following is false ?

(A) If (x_n) is a convergent sequence then $\left(x_n^2\right)$ is convergent.

(B) If (x_n) is a convergent sequence, and $x_n \geq 0$ for every n, then $\left(\sqrt{x_n}\right)$ is convergent.

(C) If $\left(x_n^2\right)$ is a convergent sequence then (x_n) is convergent.

(D) If (x_n) is a convergent sequence then $\left(x_n^3\right)$ is convergent.

12. If $0 < a < b$, then $\lim \dfrac{a^{n+1} + b^{n+1}}{a^n + b^n}$ is :

(A) b. (B) a.

(C) $a + b$. (D) ∞.

13. The limit of the sequence defined inductively by, $x_1 = 1$ and $x_{n+1} = 2 + \dfrac{1}{x_n}$ is :

(A) $1 - \sqrt{2}$. (B) $1 + \sqrt{2}$.

(C) $2 + \sqrt{2}$. (D) $2 - \sqrt{2}$.

14. Which of the following sequences with n^{th} term x_n diverges ?

(A) $x_n = 1 - \dfrac{(-1)^n}{n}$. (B) $x_n = \dfrac{1-(-1)^n}{n}$.

(C) $x_n = 1 - (-1)^n + \dfrac{1}{n}$. (D) $x_n = \dfrac{(-1)^n (n+1)}{n^2 + 1}$.

15. Which of the following statement is *not* true about closed sets ?

(A) Arbitrary union of closed sets is closed.

(B) Arbitrary intersection of closed sets is closed.

(C) If $X = (x_n)$ is a sequence of elements in a closed set F, then lim X belongs to F.

(D) A subset of R is closed if and only if it contains all of its cluster points.

16. Which of the following statements is *not* true about Cantor set ?

(A) Cantor set is closed.

(B) Cantor set is uncountable..

(C) he compliment of Cantor set in [0, 1] has length 1.

(D) Cantor set has non-empty open intervals as subsets.

17. If $z = (x, y)$ is a complex number its inverse z^{-1} is :

(A) $\left(\frac{x}{(x^2+y^2)}, \frac{y}{(x^2+y^2)}\right)$.

(B) $\left(\frac{x}{(x^2+y^2)}, \frac{-y}{(x^2+y^2)}\right)$.

(C) $\left(\frac{y}{(x^2+y^2)}, \frac{x}{(x^2+y^2)}\right)$.

(D) $\left(\frac{y}{(x^2+y^2)}, \frac{-x}{(x^2+y^2)}\right)$

18 $(1-i)^4$ is equal to :

(A) 4.

(B) $4i$.

(C) -4.

(D) $-4i$.

19. If $= \frac{-2}{1+\sqrt{3}i}$, then Arg z is :

(A) $\frac{\pi}{3}$.

(B) $-\frac{\pi}{3}$.

(C) $\frac{2\pi}{3}$.

(D) $-\frac{2\pi}{3}$.

20. $\left|e^{i\theta}\right|$ is equal to :

(A) $\sqrt{2}$.

(B) $-\sqrt{2}$.

(C) 1.

(D) -1.

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FIFTH SEMESTER U.G. (CUCBCSS—UG) DEGREE [SPECIAL] EXAMINATION, NOVEMBER 2020

Mathematics

MAT 5B 06—ABSTRACT ALGEBRA

(Multiple Choice Questions for SDE Candidates)

Time : 15 Minutes	Total No. of Questions : 20	Maximum : 20 Marks

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MAT 5B 06—ABSTRACT ALGEBRA

(Multiple Choice Questions for SDE Candidates)

1. Which of the following defines a binary operation on Z^+ ?

   (A) $a * b = a - b$.

   (B) $a * b = c$, where c is the smallest integer greater than both a and b.

   (C) $a * b = c$, where c is at least 5 more than $a + b$.

   (D) $a * b = c$, where c is the largest integer less than the product of a and b.

2. If b and c are the inverses of some element a in a group G then :

   (A) $b = c$.

   (B) $b \neq c$.

   (C) b = kc for some $k \in N$.

   (D) None of these.

3. On Q, which of the following does not define a binary operation ?

   (A) $a * b = |a| b$.

   (B) $a * b = (a - b)^2$.

   (C) $a * b = +\sqrt{ab}$.

   (D) None of these.

4. Let * be the binary operation defined on Q^+ as $a * b\ ab/2$. Then inverse of the element a is :

   (A) $2a$.

   (B) $4/a$.

   (C) a^2.

   (D) None of these.

5. Which of the following are true ?

   (1) A group may have more than one identity element.

   (2) Any two groups of three elements are isomorphic.

   (3) Every group of at most three elements is abelian.

   (A) 2 and 3.

   (B) 1 and 2.

   (C) 1 and 3.

   (D) All.

6. Let G = {1, –1, i, –i} where, be a set of four elements. Which of the following is a binary operation on G ? (1) $a * b = a + b$. (2) $a * b - a.b$.

   (A) Only 1.

   (B) Only 2.

   (C) Both.

   (D) None of these.

7. In a group G, $(a * b)^2 = a^2 * b^2$ for all $a, b \in$ G . This statement is :

   (A) Always true.

   (B) True if G is finite.

   (C) True if G is a multiplicative group.

   (D) True if G is abelian.

8. If a group G is of order 31, then which of the following is false ?

   (A) G is abelian.

   (B) G is cyclic.

   (C) G is abelian but not cyclic.

   (D) Both abelian and cyclic.

9. The Klein 4-group is isomorphic to ————————.

   (A) $Z_2 \times Z_4$.

   (B) $Z_2 \times Z_2$.

   (C) Z_4.

   (D) None of these.

10. Order of (2, 2) in $Z_4 \times Z_6$ is ————————.

    (A) 2

    (B) 6.

    (C) 4.

    (D) 12.

11. Which of the following is true ?

    (A) Every cyclic group has a unique generator.

    (B) In a cyclic group, every element is a generator.

    (C) Every cyclic group has at least two generators.

    (D) None of these.

12. Which of the following is a cyclic group with only one generator ?

    (A) Z_2.

    (B) (Z, +).

    (C) Klein-4 group.

    (D) None of these.

13. Let $\sigma = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 3 & 1 & 4 & 5 & 6 & 2 \end{pmatrix}$. Then σ^6 equals :

    (A) $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 3 & 1 & 4 & 5 & 6 & 2 \end{pmatrix}$

    (B) $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 1 & 2 & 3 & 4 & 5 & 6 \end{pmatrix}$.

    (C) $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 3 & 1 & 4 & 5 & 6 & 2 \end{pmatrix}$

    (D) None of these.

14. The product (1 3 6) (2 4) of two permutation is :

(A) $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 3 & 4 & 6 & 2 & 5 & 1 \end{pmatrix}$.

(B) $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 3 & 1 & 2 & 5 & 4 & 6 \end{pmatrix}$.

(C) $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 2 & 3 & 5 & 6 & 1 & 4 \end{pmatrix}$.

(D) $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 2 & 3 & 5 & 4 & 6 & 1 \end{pmatrix}$.

15. Which of the following is true ?

(A) Every function is a permutation if and only if it is one to one.

(B) The symmetric group S3 is cyclic.

(C) The symmetric group Sn is not cyclic for any n.

(D) Every function from a finite set onto itself must be one to one.

16. Which of the following is an even permutation ?

(A) $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \\ 3 & 4 & 5 & 1 & 6 & 2 & 1 & 8 \end{pmatrix}$.

(B) $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \\ 2 & 1 & 4 & 5 & 3 & 7 & 8 & 6 \end{pmatrix}$.

(C) $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \\ 1 & 4 & 3 & 5 & 2 & 6 & 8 & 7 \end{pmatrix}$.

(D) None of these.

17. What is the largest possible order of a cyclic subgroup of $Z_{12} \times Z_{15}$?

(A) 60.

(B) 30.

(C) 180.

(D) None of these.

18. In a non-abelian group the element a has order 108. Then the order of a 12 is :

(A) 54.

(B) 27.

(C) 18.

(D) 9.

19. f is a homomorphism f :(R, +) $\rightarrow$ (Z, x) such that f(2) = 3. Then f(6) I is :

(A) 6.

(B) 9.

(C) 18.

(D) 27.

20. Which of the following is not true ?

(A) Every subgroup of every group has left cosets.

(B) A subgroup of a group is a left coset of itself.

(C) An is of index 2 in Sn for $n > 1$.

(D) None of these.

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FIFTH SEMESTER U.G. DEGREE [SPECIAL] EXAMINATION NOVEMBER 2020

(CUCBCSS—UG)

Mathematics

MAT 5B 05—VECTOR CALCULUS

(Multiple Choice Questions for SDE Candidates)

Time : 15 Minutes	Total No. of Questions : 20	Maximum : 20 Marks

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MAT 5B 05—VECTOR CALCULUS

(Multiple Choice Questions for SDE Candidates)

1. The angle between the vectors $a = [1, 2, 3]$ and $b = [0, -2, 1]$ is :

   (A) $\cos^{-1} \frac{1}{\sqrt{60}}$.
   (B) $\cos^{-1} \frac{-1}{\sqrt{70}}$.
   (C) $\cos^{-1} \frac{1}{\sqrt{70}}$.
   (D) $\cos^{-1} \frac{1}{\sqrt{80}}$.

2. The straight line through the point $(1, 3)$ in the xy plane and perpendicular to the straight line $x - 2y + 2 = 0$ is :

   (A) $3x - y = 2$.
   (B) $x + y = 1$.
   (C) $2x + y = 5$.
   (D) $2x - y = 5$.

3. The parametric equations for the line through $(-3, 2, -3)$ and $(1, -1, 4)$ are :

   (A) $x = 1 + 4t,\ y = -1 - 3t,\ z = 4 + 7t$.
   (B) $x = 2 + 4t,\ y = -2 - 3t,\ z = -4 + 7t$.
   (C) $x = 3 + 4t,\ y = 8 - 3t,\ z = 5 + 7t$.
   (D) $x = 1 - 4t,\ y = -1 + 3t,\ z = -4 - 7t$.

4. The point of intersection of the line $x = \frac{8}{3} + 2t, y = -2t, z = 1 + t$ and the plane $3x + 2y + 6z = 6$ is:

   (A) $(1, 1, 2)$.
   (B) $(2, 0, 1)$.
   (C) $\left(\frac{2}{3}, 2, 0\right)$.
   (D) $(0, 1, 3)$.

5. If $r(t) = \sin ti + e^{-t} y + 3k$, then $\frac{dr}{dt}$ is :

   (A) $\sin ti + 3k$.
   (B) $\cos ti + e^{-t} j + 3k$.
   (C) $\cos ti - e^{-t} j$.
   (D) $\sin ti - e^{-t} j$.

6. The domain of the function $f(x, y, z) = xy \ln(z)$:

   (A) Entire Space
   (B) $\{(x, y, z) : xyz \neq 0\}$.
   (C) Half space $z > 0$.
   (D) Hald space $z < 0$.

7. Which of the following holds for the function $f(x, y) = \frac{4x^6 y^2}{x^{12} + y^4}$?

   (A) $\lim_{(x, y) \to (0, 0)} f(x, y)$ exists.
   (B) $\lim_{(x, y) \to (0, 0)} f(x, y)$ doesn't exists.
   (C) $\lim_{(x, y) \to (0, 0)} f(x, y) = 0$.
   (D) None of these.

8. Let $f(x, y) = x - y$ and $g(z, y) = e^z$ be two continuous functions. Then the composition function $g(f(x, y)) = e^{x-y}$ is :

(A) Discontinuous. (B) Continuous.

(C) Continuous at origin. (D) None of these.

9. The function $f(x, y) = xy$ has a :

(A) Local maximum.

(B) Local minimum.

(C) Both local maximum and minimum.

(D) No local extreme values.

10. The minimum value that the function $f(x, y) = xy$ takes on the ellipse $\frac{x^2}{8} + \frac{y^2}{2} = 1$ is :

(A) 2. (B) – 2.

(C) 4. (D) – 4.

11. The plane $x + y + z = 1$ cuts the cylinder $x^2 + y^2 = 1$ in an ellipse. The points on the ellipse that lies closest to the origin are :

(A) $(1, 0, 0)$ and $(0, 0, 1)$. (B) $(0, 1, 0)$ and $(0, 0, 1)$.

(C) $(1, 0, 0)$ and $(0, 1, 0)$. (D) $(1, 0, 0)$ and $(0, 1, 1)$.

12. What is the value of $\iint xydxdy$ over the first guadrant of the circle $x^2 + y^2 = a^2$?

(A) $\frac{a^2}{4}$. (B) $\frac{a^2}{8}$.

(C) $\frac{a^4}{4}$. (D) $\frac{a^4}{8}$.

13. A coil spring lies along the helix $r(t) = (\cos 4t)\mathrm{I} + (\sin 4t)j + k, 0 \le t \le 2\pi$. The spring's density is a constant, $\delta = 1$. Then the radius of gyration of the spring about the z-axis is :

(A) 1. (B) 2.

(C) 3. (D) 4.

14. The gradient field of $f(x, y, z) - xyz$ is :

(A) $yzi + xzj + xyk$. (B) $xyi + xzj + yzk$.

(C) $xzi + yzj + xyk$. (D) None of these.

15. If $\nabla\varnothing = \left(y + y^2 + z^2\right) i + (x + z + 2xy)\, j + (y + 2xz)\, k$ and $\varnothing(1,1,1) = 3$, then what is $\varnothing$?

(A) $xz + xy + yz^2 - 1.$ (B) $xz + yz + xz^2.$

(C) $xy^2 + xz^2 - 1.$ (D) $xy + xy^2 + xz^2 + yz - 1.$

16. Which among the following is the work done in moving a particle once round a circle C in the xy-plane. Given the circle has centre at the origin and radius 3 and the force field is given by $F = (2x - y + z)\, i + \left(x + y - z^2\right) j + (3x - 2y + 4z)\, k.$

(A) 8π. (B) 80π.

(C) 88π. (D) 18π.

17. If $F = \left(3x^2 + 6y\right) j - 14yzj + 20xz^2k,$ then the value of $\int_C F \cdot dr$ where C is a curve from $(0,0,0)$ to $(1,1,1)$ with parametric from $x = t,\ y = t^2,\ z = t^3$ is :

(A) 13. (B) 7.

(C) 5. (D) 11.

18. If $r^\wedge$ is the unit vector in the direction of r and $r = |r|$, then div $\left(r^\wedge\right)$ is :

(A) $\frac{r}{2}$. (B) r.

(C) zr. (D) $\frac{z}{r}$.

19. Vector product is :

(A) Commutative. (B) Anticommutative.

(C) Associative. (D) Not distributive wet vector addition.

20. If F,G are differentiable vector functions and $\varnothing$ is a differentiable scalar function. Then :

(A) curl $(F \times G) = (\text{grad } \varnothing) \times F + \varnothing$ curl (F).

(B) div $(F \times G) = -$ F curl G + g curl F.

(C) div $(F \times G) = (G, \nabla) F - (F\, \nabla) G + F$ div G $-$ G div F.

(D) curl $(F \times G) = F$ curl G $-$ G curl F.