SECTION – A
MULTIPLE CHOICE QUESTIONS (MCQ)

Q.1 – Q. 10 carry one mark each.

1. **Which one of the following is TRUE?**
(A) $\mathbb{Z}_n$ is cyclic if and only if n is prime
(B) Every proper subgroup of $\mathbb{Z}_n$ is cyclic
(C) Every proper subgroup of S_4 is cyclic
(D) If every proper subgroup of a group is cyclic, then the group is cyclic

2. **Let $a_n = \frac{b_{n+1}}{b_n}$, where $b_1 = 1$, $b_2 = 1$ and $b_{n+2} = b_n + b_{n+1}, n \in \mathbb{N}$. Then $\lim_{n\to\infty} a_n$ is**
(A) $\frac{1-\sqrt{5}}{2}$
(B) $\frac{1-\sqrt{3}}{2}$
(C) $\frac{1+\sqrt{3}}{2}$
(D) $\frac{1+\sqrt{5}}{2}$

3. **If $\{v_1, v_2, v_3\}$ is a linearly independent set of vectors in a vector over $\mathbb{R}$, then which one of the following sets is also linearly independent?**
(A) $\{v_1 + v_2 - v_3,\ 2v_1 + v_2 + 3v_3,\ 5v_1 + 4v_2\}$
(B) $\{v_1 - v_2,\ v_2 - v_3,\ v_3 - v_1\}$
(C) $\{v_1 + v_2 - v_3,\ v_2 + v_3 - v_1,\ v_3 + v_1 - v_2,\ v_1 + v_2 + v_3\}$
(D) $\{v_1 + v_2,\ v_2 + 2v_3,\ v_3 + 3v_1\}$

4. **Let a be a positive real number. If f is a continuous and even function defined on the interval $[-a, a]$, then $\int_{-a}^{a} \frac{f(x)}{1+e^x} dx$ is equal to**
(A) $\int_0^a f(x)dx$
(B) $2\int_0^a \frac{f(x)}{1+e^x}dx$
(C) $2\int_0^a f(x)dx$
(D) $2a\int_0^a \frac{f(x)}{1+e^x}dx$

5. **The tangent plane to the surface $z = \sqrt{x^2 + 3y^2}$ at $(1, 1, 2)$ is given by**
(A) $x - 3y + z = 0$
(B) $x + 3y - 2z = 0$
(C) $2x + 4y - 3z = 0$
(D) $3x - 7y + 2z = 0$

6. **In $\mathbb{R}^3$, the cosine of the acute angle between the surfaces $x^2 + y^2 + z^2 - 9 = 0$ and $z - x^2 - y^2 + 3 = 0$ at the point $(21\ 11\ 2)$ is**
(A) $\frac{8}{5\sqrt{21}}$
(B) $\frac{10}{5\sqrt{21}}$
(C) $\frac{8}{3\sqrt{21}}$
(D) $\frac{10}{3\sqrt{21}}$

7. **If $f : \mathbb{R}^3 \to \mathbb{R}$ be a scalar field, $\vec{v} : \mathbb{R}^3 \to \mathbb{R}^3$ be a vector field and let $\vec{a} \in \mathbb{R}^3$ be a constant vector. If $\vec{r}$ represents the position vector $x\hat{i} + y\hat{j} + z\hat{k}$, then which one of the following is FALSE?**

(A) $curl\ (f\ \vec{v}) = grad\ (f) \times \vec{v} + f\ curl\ (\vec{v})$

(B) $div\ (grad(f)) = \left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} + \frac{\partial^2}{\partial z^2}\right) f$

(C) $curl\ (\vec{a} \times \vec{r}) = 2|\vec{a}|\ \vec{r}$

(D) $div\left(\frac{\vec{r}}{|\vec{r}|^3}\right) = 0$, for $\vec{r} \neq \vec{0}$

8. **In $\mathbb{R}^2$, the family of trajectories orthogonal to the family of asteroids $x^{2/3} + y^{2/3} = a^{2/3}$ is given by**

(A) $x^{4/3} + y^{4/3} = c^{4/3}$

(B) $x^{4/3} - y^{4/3} = c^{4/3}$

(C) $x^{5/3} - y^{5/3} = c^{5/3}$

(D) $x^{2/3} - y^{2/3} = c^{2/3}$

9. **Consider the vector space V over $\mathbb{R}$ of polynomial functions of degree less than or equal to 3 defined on $\mathbb{R}$. Let $T : V \to V$ be defined by $(Tf)(x) = f(x) - xr'(x)$. Then the rank of T is**

(A) 1

(B) 2

(C) 3

(D) 4

10. **Let $S_n = 1 + \frac{1}{1!} + \frac{1}{2!} + \cdots + \frac{1}{n!}$ for $n \in \mathbb{N}$. Then which one of the following is TRUE for the sequence $\{s_n\}_{n=1}^{\infty}$**

(A) $\{s_n\}_{n=1}^{\infty}$ converges in $\mathbb{Q}$

(B) $\{s_n\}_{n=1}^{\infty}$ is a Cauchy sequence but does not converges in $\mathbb{Q}$

(C) the subsequence $\{s_{k^n}\}_{n=1}^{\infty}$ is convergent in $\mathbb{R}$, only when k is even natural number

(D) $\{s_n\}_{n=1}^{\infty}$ is not a Cauchy sequence

Q.11 – Q.30 carry two marks each.

11. **Let $a_n = \begin{cases} 2 + \frac{(-1)^{\frac{n-1}{2}}}{n}, & \text{if } n \text{ is odd} \\ 1 + \frac{1}{2^n}, & \text{if } n \text{ is even} \end{cases}$, $n \in \mathbb{N}$. Then which one of the following is TRUE?**

(A) $\sup\{a_n \mid n \in \mathbb{N}\} = 3$ and $\inf\{a_n \mid n \in \mathbb{N}\} = 1$

(B) $\liminf(a_n) = \limsup(a_n) = \frac{3}{2}$

(C) $\sup\{a_n \mid n \in \mathbb{N}\} = 2$ and $\inf\{a_n \mid n \in \mathbb{N}\} = 1$

(D) $\liminf(a_n) = \limsup(a_n) = 3$

12. **Let $a, b, c \in \mathbb{R}$. Which of the following values of a, b, c do NOT result in the convergence of the series $\sum_{n=3}^{\infty} \frac{a^n}{n^b (\log_e n)^c}$?**

(A) $|a| < 1, b \in \mathbb{R}, c \in \mathbb{R}$

(B) $a = 1, b > 1, c \in \mathbb{R}$

(C) $a = 1, b \geq 0, c < 1$

(D) $a = -1, b \geq 0, c > 0$

13. **Let $a_n = n + \frac{1}{n}, n \in \mathbb{N}$. Then the sum of the series $\sum_{n=1}^{\infty}(-1)^{n+1} \frac{a_{n+1}}{n!}$ is**

(A) $e^{-1} - 1$

(B) e^{-1}

(C) $1 - e^{-1}$

(D) $1 + e^{-1}$

14. Let $a_n = \frac{(-1)^n}{\sqrt{1+n}}$ and let $c_n = \sum_{n=0}^{n} a_{n-k}a_k$, where $n \in \mathbb{N} \cup \{0\}$. Then which one of the following is TRUE?

(A) Both $\sum_{n=0}^{\infty} a_n$ and $\sum_{n=0}^{\infty} c_n$ are convergent

(B) $\sum_{n=0}^{\infty} a_n$ is convergent but $\sum_{n=0}^{\infty} c_n$ is not convergent

(C) $\sum_{n=0}^{\infty} c_n$ is convergent but $\sum_{n=0}^{\infty} a_n$ is not convergent

(D) Neither $\sum_{n=0}^{\infty} a_n$ nor $\sum_{n=0}^{\infty} c_n$ is convergent

15. Suppose that $f, g : \mathbb{R} \to \mathbb{R}$ are differentiable functions such that f is strictly incrasing and g is strictly decreasing. Define $p(x) = f(g(x))$ and $q(x) = f(g(x)), \forall x \in \mathbb{R}$. Then, for $t > 0$, the sign of $\int_0^t p'(x)(q'(x) - 3)dx$ is

(A) positive

(B) negative

(C) dependent on t

(D) dependent on f and g

16. For $x \in \mathbb{R}$, let $f(x) = \begin{cases} x^3 \sin\left(\frac{1}{x}\right), & x \neq 0 \\ 0, & x = 0 \end{cases}$. Then which one of the following is FALSE?

(A) $\lim_{x\to\infty} \frac{f(x)}{x} = 0$

(B) $\lim_{x\to\infty} \frac{f(x)}{x^2} = 0$

(C) $\frac{f(x)}{x^2}$ has infinitely many maxima and minima on the interval $(0, 1)$

(D) $\frac{f(x)}{x^4}$ is continuous at $x = 0$ but not differentiable at $x = 0$

17. Let $f(x, y) = \begin{cases} \frac{xy}{(x^2+y^2)^\alpha}, & (x, y) \neq (0, 0) \\ 0, & (x, y) = (0, 0) \end{cases}$. Then which one of the following is TRUE for f at the point (0, 0)?

(A) For $\alpha = 1$, f is continuous but not differentiable

(B) For $\alpha = \frac{1}{2}$, f is continuous and differentiable

(C) For $\alpha = \frac{1}{4}$, f is continuous and differentiable

(D) For $\alpha = \frac{3}{4}$, f is neither continuous nor differentiable

18. Let $a, b \in \mathbb{R}$ and let $f : \mathbb{R} \to \mathbb{R}$ be a thrice differentiable function. If $z = e^u f(v)$, where $u = ax + by$ and $v = ax - by$, then which one of the following is TRUE?

(A) $b^2 z_{xx} - a^2 z_{yy} = 4a^2 b^2 e^u f'(v)$

(B) $b^2 z_{xx} - a^2 z_{yy} = -4e^u f'(v)$

(C) $bz_x + az_y = abz$

(D) $bz_x + az_y = -abz$

19. Consider the region D in the yz plane bounded by the line $y = \frac{1}{2}$ and the curve $y^2 + z^2 = 1$, where $y \geq 0$. If the region D is revolved about the z-axis in $\mathbb{R}^3$, then the volume of the resulting solid is

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

(B) $\frac{2\pi}{\sqrt{3}}$

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

(D) $\pi\sqrt{3}$

20. If $\vec{F}(x,y) = (3x - 8y)\hat{\imath} + (4y - 6xy)\hat{\jmath}$ for $(x,y) \in \mathbb{R}^2$, then $\oint_C \vec{F} \cdot d\vec{r}$, wehre C is the boundary of the triangular region bounded by the lines $x = 0, y = 0$ and $x + y = 1$ oriented in the anti-clockwise direction, is

(A) $\frac{5}{2}$
(B) 3
(C) 4
(D) 5

21. Let U, V and W be finite dimensional real vector spaces, $T : V \to V, S ; V \to W$ and $P : W \to U$ be linear transformations. If range (ST) = nullspace (P), nullspace (ST) = range (P) and rank (T) = rank (S), then which one of the following is TRUE?

(A) nullity of T = nullity of S
(B) dimension of $U \neq$ dimension of W
(C) If dimension $V = 3$, dimension of $U = 4$, then P is not identically zero
(D) If dimension $V = 4$, dimension of $U = 3$, and T is one-one, then P is identically zero

22. Let $y(x)$ be the solution of the differential equation $\frac{dy}{dx} + y = f(x)$, for $x \geq 0, y(0) = 0$, where $f(x) = \begin{cases} 2, & 0 \leq x < 1 \\ 0, & x \geq 1 \end{cases}$. Then $y(x) =$

(A) $2(1 - e^{-x})$ when $0 \leq x < 1$ and $2(e - 1)e^{-x}$ when $x \geq 1$
(B) $2(1 - e^{-x})$ when $0 \leq x < 1$ and 0 when $x \geq 1$
(C) $2(1 - e^{-x})$ when $0 \leq x < 1$ and $2(1 - e^{-1})e^{-x}$ when $x \geq 1$
(D) $2(1 - e^{-x})$ when $0 \leq x < 1$ and $2\, e^{1-x}$ when $x \geq 1$

23. An integrating factor of the differential equation $\left(y + \frac{1}{3}y^3 + \frac{1}{2}x^2\right)dx + \frac{1}{4}(x + x\,y^2)dy = 0$ is

(A) x^2
(B) $3 \log_e x$
(C) x^3
(D) $2 \log_e x$

24. A particular integral of the differential equation $y'' + 3y' + 2y = e^{e^x}$ is

(A) $e^{e^x}e^{-x}$
(B) $e^{e^x}e^{-2x}$
(C) $e^{e^x}e^{2x}$
(D) $e^{e^x}e^{x}$

25. Let G be a group satisfying the property that $f : G \to \mathbb{Z}_{221}$ is a homomorphism implies $f(g) = 0, \forall g \in G$. Then a possible group G is

(A) $\mathbb{Z}_{21}$
(B) $\mathbb{Z}_{51}$
(C) $\mathbb{Z}_{91}$
(D) $\mathbb{Z}_{119}$

26. Let H be the quotient group $\mathbb{Q}/\mathbb{Z}$. Consider the following statements.
I. Every cyclic subgroup of H is finite.
II. Every finite cyclic group is isomorphic to a subgroup of H.
Which one of the following holds?

(A) I is TRUE but II is FALSE
(B) II is TRUE but I is FALSE
(C) both I and II are TRUE
(D) neither I nor II is TRUE

27. **Let I denote the 4×4 identity matrix. If the roots of the characteristic polynomial of a 4×4 matrix M are $\pm\sqrt{\frac{1\pm\sqrt{5}}{2}}$, then $M^8 =$**

(A) $I + M^2$
(B) $2I + M^2$
(C) $2I + 3M^2$
(D) $3I + 2M^2$

28. **Consider the group $\mathbb{Z}^2 = \{(a, b) | a, b \in \mathbb{Z}\}$ under component-wise addition. Then which of the following is a subgroup of $\mathbb{Z}^2$?**

(A) $\{(a, b) \in \mathbb{Z}^2 \mid ab = 0\}$
(B) $\{(a, b) \in \mathbb{Z}^2 \mid 3a + 2b = 15\}$
(C) $\{(a, b) \in \mathbb{Z}^2 \mid 7 \text{ divides } ab\}$
(D) $\{(a, b) \in \mathbb{Z}^2 \mid 2 \text{ divides } a \text{ and } 3 \text{ divides } b\}$

29. **Let $f : \mathbb{R} \to \mathbb{R}$ be a function and let J be a bounded open interval in $\mathbb{R}$. Define $W(f, J) = \sup\{f(x) | x \in J\} - \inf\{f(x) | x \in J\}$. Which one of the following is FALSE?**

(A) $W(f, J_1) \leq W(f, J_2)$ if $J_1 \subset J_2$
(B) If f is a bounded function in J and $J \supset J_1 \supset J_2 \ldots \supset J_n \supset \cdots$ such that the length of the interval J_n tends to 0 as $n \to \infty$, then $\lim_{n\to\infty} W(f, J_n) = 0$
(C) If f is discontinuous at a point $a \in J$, then $W(f, J) \neq 0$
(D) If f is continuous at a point $a \in J$, then for any given $\epsilon > 0$ there exists an interval $I \subset J$ such that $W(f, I) < \epsilon$

30. **For $x > \frac{-1}{2}$, let $f_1(x) = \frac{2x}{1+2x}$, $f_2(x) = \log_e(1 + 2x)$ and $f_3(x) = 2x$. Then which one of the following is TRUE?**

(A) $f_3(x) < f_2(x) < f_1(x)$ for $0 < x < \frac{\sqrt{3}}{2}$
(B) $f_1(x) < f_3(x) < f_2(x)$ for $x > 0$
(C) $f_1(x) + f_2(x) < \frac{f_3(x)}{2}$ for $x > \frac{\sqrt{3}}{2}$
(D) $f_2(x) < f_1(x) < f_3(x)$ for $x > 0$

SECTIOIN – B
MULTIPLE SELECT QUESTIONS (MSQ)

Q.31 – Q. 40 carry two marks each.

31. **Let $f : \mathbb{R}\backslash\{0\} \to \mathbb{R}$ be defined by $f(x) = x + \frac{1}{x^3}$. On which of the following interval(s) is f one-one?**
(A) $(-\infty, -1)$
(B) $(0, 1)$
(C) $(0, 2)$
(D) $(0, \infty)$

32. **The solution(s) of the differential equation $\frac{dy}{dx} = (\sin 2x)\, y^{1/3}$ satisfying $y(0) = 0$ is (are)**
(A) $y(x) = 0$
(B) $y(x) = -\sqrt{\frac{8}{27}}\sin^3 x$
(C) $y(x) = \sqrt{\frac{8}{27}}\sin^3 x$
(D) $y(x) = \sqrt{\frac{8}{27}}\cos^3 x$

33. **Suppose f, g, h are permutation of the set $\{\alpha, \beta, \gamma, \delta\}$, where**
f interchanges α and β but fixed γ and δ,
g interchanges β and γ but fixed α and δ,
h interchanges γ and δ but fixed α and β,
Which of the following permutations interchange(s) α and δ but fix(es) β and γ?
(A) $f \circ g \circ h \circ g \circ f$
(B) $g \circ h \circ f \circ h \circ g$
(C) $g \circ f \circ h \circ f \circ g$
(D) $h \circ g \circ f \circ g \circ h$

34. **Let P and Q be two non-empty disjoint subsets of $\mathbb{R}$. Which of the following is (are) FALSE?**
(A) If P and Q are compact, then $P \cup Q$ is also compact
(B) If P and Q are not connected, then $P \cup Q$ is also not connected
(C) If $P \cup Q$ and P are closed, then Q is closed
(D) If $P \cup Q$ and P are open, then Q is open

35. **Let $\mathbb{C}^* = \mathbb{C}\backslash\{0\}$ denote the group of non-zero complex numbers under multiplication. Suppose $Y_n = \{z \in \mathbb{C} \mid z^n = 1\}, n \in \mathbb{N}$. Which of the following is (are) subgroup(s) of $\mathbb{C}^*$?**
(A) $\bigcup_{n=1}^{100} Y_n$
(B) $\bigcup_{n=1}^{\infty} Y_{2^n}$
(C) $\bigcup_{n=100}^{\infty} Y_n$
(D) $\bigcup_{n=1}^{\infty} Y_n$

36. **Suppose $\alpha, \beta, \gamma \in \mathbb{R}$. Consider the following system of linear equations. $x + y + z = \alpha, x + \beta y + z = \gamma, x + y + \alpha z = \beta$. If the system has at least one solution, then which of the following statements is (are) TRUE?**
(A) If $\alpha = 1$ then $\gamma = 1$
(B) If $\beta = 1$ then $\gamma = \alpha$
(C) If $\beta \neq 1$ then $\alpha = 1$
(D) If $\gamma = 1$ then $\alpha = 1$

37. **Let $m, n \in \mathbb{N}, m < n$, $P \in M_{n\times m}(\mathbb{R})$, $Q \in M_{m\times n}(\mathbb{R})$. Then which of the following is (are) NOT possible?**

(A) $rank\ (PQ) = n$

(B) $rank\ (QP) = m$

(C) $rank\ (PQ) = m$

(D) $rank\ (QP) = \left\lceil \frac{m+n}{2} \right\rceil$, the smallest integer larger than or equal to $\frac{m+n}{2}$

38. **If $\vec{F}(x, y, z) = (2x + 3yz)\hat{\imath} + (3xz + 2y)\hat{\jmath} + (3xy + 2z)\hat{k}$ for $(x, y, z) \in \mathbb{R}^3$, then which among the following is (are) TRUE?**

(A) $\nabla \times \vec{F} = \vec{0}$

(B) $\oint_C \vec{F} \cdot d\,\vec{r} = 0$ along any simple closed curve C

(C) There exists a scalar function $\phi : \mathbb{R}^3 \to \mathbb{R}$ such that $\nabla \cdot \vec{F} = \phi_{xx} + \phi_{yy} + \phi_{zz}$

(D) $\nabla \cdot \vec{F} = 0$

39. **Which of the following subsets of $\mathbb{R}$ is (are) connected?**

(A) $\{x \in \mathbb{R} \mid x^2 + x > 4\}$

(B) $\{x \in \mathbb{R} \mid x^2 + x < 4\}$

(C) $\{x \in \mathbb{R} \mid |x| < |x - 4|\}$

(D) $\{x \in \mathbb{R} \mid |x| > |x - 4|\}$

40. **Let S be a subset of $\mathbb{R}$ such that 2018 is an interior point of S. Which of the following is (are) TRUE?**

(A) S contains an interval

(B) There is a sequence in S which does not converge to 2018

(C) There is an element $y \in S, y \neq 2018$ such thath y is also an interior point of S

(D) There is a point $z \in S$, such thath $|z - 2018| = 0.002018$

SECTION – C
NUMERICAL ANSWER TYPE (NAT)

Q.41 – Q.50 carry one mark each.

41. The order of the element (1 2 3) (2 4 5) (4 5 6) in the group S_6 is _____

42. Let $\phi(x,y,z) = 3y^2 + 3yz$ for $(x,y,z) \in \mathbb{R}^3$. Then the absolute value of the directional derivative of ϕ in the direction of the line $\frac{x-1}{2} = \frac{y-2}{-1} = \frac{z}{-2}$, at the point $(1,-2,1)$ is _____

43. Let $f(x) = \sum_{n=0}^{\infty}(-1)^n x(x-1)^n$ for $0 < x < 2$. Then the value of $f\left(\frac{\pi}{4}\right)$ is _____

44. Let $f : \mathbb{R}^2 \to \mathbb{R}$ be given by $f(x,y) = \begin{cases} \frac{x^2y(x-y)}{x^2+y^2}, & (x,y) \neq (0,0) \\ 0, & (x,y) = (0,0) \end{cases}$. Then $\frac{\partial}{\partial x}\left(\frac{\partial f}{\partial y}\right) - \frac{\partial}{\partial y}\left(\frac{\partial f}{\partial x}\right)$ at the point $(0,0)$ is_____

45. Let $f(x,y) = \sqrt{x^3y}\sin\left(\frac{\pi}{2}e^{\left(\frac{y}{x}-1\right)}\right) + xy\cos\left(\frac{\pi}{3}e^{\left(\frac{x}{y}-1\right)}\right)$ for $(x,y) \in \mathbb{R}^2, x > 0, y > 0$. Then $f_x(1,1) + f_y(1,1) =$ _____

46. Let $f : [0,\infty) \to [0,\infty)$ be continuous on $[0,\infty)$ and differentiable on $(0,\infty)$. If $f(x) = \int_0^x \sqrt{f(t)}\,dt$, then $f(6) =$_____

47. Let $a_n = \frac{(1+(-1)^n)}{2^n} + \frac{(1+(-1)^{n-1})}{3^n}$. Then the radius of convergence of the power series $\sum_{n=1}^{\infty} a_n x^n$ about $x = 0$ is _____

48. Let A_6 be the group of even permutations of 6 distinct symbols. Then the number of elements of order 6 in A_6 is _____

49. Let W_1 be the real vector space of all 5×2 matrices such that the sum of the entries in each row is zero. Let W_2 be the real vector space of 5×2 matrices such that the sum of the entries in each column in zero. Then the dimension of the space $W_1 \cap W_2$ is _____

50. The coefficient of x^4 in the power series expansion of $e^{\sin x}$ about $x = 0$ is _____ (correct up to three decimal places).

Q. 51 – Q. 60 carry two marks each.

51. Let $a_k = (-1)^{k-1}, s_n = a_1 + a_2 + \cdots + a_n$ and $\sigma_n = (s_1 + s_2 + \cdots + s_n)/n$, where $k, n \in \mathbb{N}$. Then $\lim_{n\to\infty} \sigma_n$ is _____ (correct up to one decimal places).

52. Let $f : \mathbb{R} \to \mathbb{R}$ be such that f'' is continuous on $\mathbb{R}$ and $f(0) = 1, f'(0) = 0$ and $f''(0) = -1$. Then $\lim_{x\to\infty}\left(f\left(\sqrt{\frac{2}{x}}\right)\right)^x$ is _____ (correct up to three decimal places).

53. Suppose x, y, z are positive real numbers such that $x + 2y + 3z = 1$. If M is the maximum value of xyz^2, then the value of $\frac{1}{M}$ is _____

54. If the volume of the solid in $\mathbb{R}^3$ bounded by the surfaces $x = -1, x = 1, y = -1, y = 1, z = 2, y^2 + z^2 = 2$ is $\alpha - \pi$, then $\alpha =$ _____

55. If $\alpha = \int_{\pi/6}^{\pi/3} \frac{\sin t + \cos t}{\sqrt{\sin 2t}}\, dt$, then the value of $\left(2 \sin \frac{\alpha}{2} + 1\right)^2$ is _____

56. The value of the integral $\int_0^1 \int_x^1 y^4 e^{xy^2}\, dy\, dx$ is _____ (correct up to three decimal places).

57. Suppose $Q \in M_{3\times 3}(\mathbb{R})$ is a matrix of rank 2. Let $T : M_{3\times 3}(\mathbb{R}) \to M_{3\times 3}(\mathbb{R})$ be the linear transformation defined by $T(P) = QP$. Then the rank of T is _____

58. The area of the parametrized surface $S = \left\{((2 + \cos u)\cos v, (2 + \cos u)\sin v, \sin u) \in \mathbb{R}^3 \mid 0 \le u \le \frac{\pi}{2}, 0 \le v \le \frac{\pi}{2}\right\}$ is _____ (correct up to two decimal places).

59. If $x(t)$ is the solution to the differential equation $\frac{dx}{dt} = x^2 t^3 + xy$, for $t > 0$, satisfying $x(0) = 1$, then the value of $x(\sqrt{2})$ is _____ (correct up to two decimal places).

60. If $y(x) = v(x)\sec x$ is the solution of $y'' - (2\tan x)\, y' + 5y = 0, -\frac{\pi}{2} < x < \frac{\pi}{2}$, satisfying $y(0) = 0$ and $y'(0) = \sqrt{6}$, then $v\left(\frac{\pi}{6\sqrt{6}}\right)$ is _____ (correct up to two decimal places).

ANSWER KEY – IIT JAM MATHEMATICS 2018

Section: A

1	2	3	4	5	6	7	8	9	10
B	D	D	A	B	C	C	B	C	B
11	12	13	14	15	16	12	18	19	20
A	C	D	B	A	D	C	A	C	B
21	22	23	24	25	26	27	28	29	30
C	A	C	B	A	C	C	D	B	C

Section: B

31	32	33	34	35
B	A,B,C	A,D	B,C,D	B,C,D
36	37	38	39	40
A,B	A,D	A,B,C	B,C,D	A,B,C

Section: C

41	42	43	44	45
4 to 4	6.5 to 7.5	1 to 1	1 to 1	3 to 3
46	47	48	49	50
9 to 9	2 to 2	0 to 0	4 to 4	-0.130 to -0.120
51	52	53	54	55
0.4 to 0.6	0.350 to 0.380	1140 to 1160	5.99 to 6.01	2.9 to 3.1
56	57	58	59	60
0.230 to 0.250	6 to 6	6.30 to 6.70	-2.80 to -2.70	0.5 to 0.5

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