**Comprehension:**

During my vist to Cuttack I participated in the birthday celebration of the late Justice Harihar Mahapatra, I went there at the invitation of justice Ranganath Mishra. For me, it was a revelation, how the independence movement, the first vision for the nation, had created the larger-than-life figure of Justice Harihar Mahapatra.

He lived to the age of ninety-two and established Cuttack Eye Hospital, Utkal University and above all organized multi-pronged efforts to remove poverty. My biography in Oriya was released. At the end of my speech the youngsters crowding around put forth many questions.

The first question was, 'Sir, tells us which are your favourite books, that you loved and which have shaped your mind?"

I said, 'Four books in my life have been very close to my heart. I cherish treading them. The first is Man the Unknown by Dr Alexis Carrel, a doctor turned-philosopher and a Nobel laureate. This book highlights how the mind and body both have to be treated in an ailment as the two are integrated. You cannot treat one and ignore the other. In Particular, children who dream of becoming doctors should read the book. They will learn that the human body a mechanical system it is a very intelligant on with a most intricate and sensitive feedback system. The second book, one I venerate, is Tiruvalluvar's Thirukkural, which provides an excellent code of life. The third Light from Many Lamps by Lillian Eichler Watson which has touched me deeply. It illuminates how we live and has been an invaluable guide to me for fifty years. And the Holy Quran is, of course, a constant companion.'

1. Choose the best option from the given alternative the book 'Man the unknown' highlights that the mind and the body are to be equally trested in a ailment as they are integrated. Replace the underlined word from a suitable synonym given below.

1. Collaborated
2. Removed
3. Disintegrated
4. Separated

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3. Find a word from the passage that means "very complicated."
1. Highlight
2. Multi-pronged
3. Invaluable
4. Intricate

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3. Find a word from the passage that is an antonym to the word 'Conceal'
1. Ailment
2. Illuminate
3. Revelation
4. Sensitive

**Comprehension:**
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4. Choose the best option from the given alternatives the book _____ had a deep impact on the author.
1. Thirukkural
2. The Holy Quran
3. Light from many lamps
4. Man the unknown

**Comprehension:**
During my vist to Cuttack I participated in the birthday celebration of the late Justice Harihar Mahapatra, I went there at the invitation of justice Ranganath Mishra. For me, it was a revelation, how the independence movement, the first vision for the nation, had created the larger-than-life figure of Justice Harihar Mahapatra.
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5. Choose the best option from the given alternative. The author participated in the birthday celebration of _____.

1. Justice Ranganath Mishra
2. Dr Alexis Carrel
3. Justice Harihar Mahapatra
4. Lillian Eichler Watson

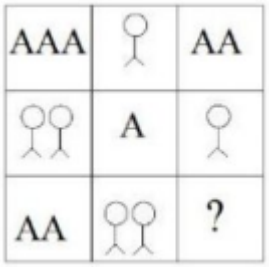
6. Given below are two statements:
Statement I: Due to disease' Pneumonia', lungs of the human body are affected.
Statement II: Lungs of human body are also affected due to disease 'Diptheria'
In the light of the above statements, choose the most appropriate answer from the options given below:
1. Both Statement I and Statement II are correct
2. Both Statement I and Statement II are incorrect
3. Statement I is correct but Statement II is incorrect
4. Statement I is incorrect but Statement II is correct

7. Match List I with List II

| LIST I | LIST II |
|---|---|
| Name of Padma Vibhushan Awardee | Awarded in the service |
| A. Ms. Prabha Atre | I. Public Affairs |
| B. Mr Kalyan Singh | II. Literature and Education |
| C. Mr. Radheyshyam Khemka | III. Civil Service |
| D. General Bipin Rawat | IV. Art |

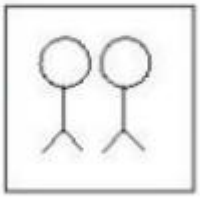
Choose the most appropriate answer from the options given below:
1. A-I. B-III, C-IV, D-II
2. A-IV, B-I, C-III, D-II
3. A-IV, B-I, C-II, D-III
4. A-I, B-IV, C-II, D-III

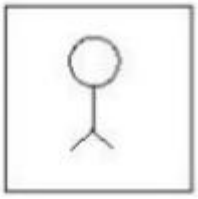
8. Find out which of the answer figures (1), (2), (3) and (4) completes the figure matrix:



1. 


2. 

3. 

4. 

9. If a man increases his speed to $\frac{9}{5}$ times his usual speed, he reaches his office 24 minutes before the office time. Find the time taken by to reach his office with usual speed.

1.50 minutes
2.52 minutes
3. 54 minutes
4.55 minutes

10. The value of $\frac{43}{3} - \left(3 + \frac{1}{3+\frac{1}{3}}\right) - \left(2 - \frac{1}{2-\frac{1}{2}}\right)$ is

1. 9
2. 9.7
3. 7.9
4. 2.7

11. Accepting something unpleasant when one can not avoid of os: _____.

1. Take a Bull by the horn
2. In the blues
3. Black and white
4. Bite the bullet

12. Pointing to a photograph. Aman tells his friend, "she is the grand daughter of the elder brothers of my father.
"How is the girl in the photograph related to Aman?
1. Sister
2. Maternal Aunt
3. Niece
4. Aunt

13. A candidate who gets 20% marks fails by 10 marks. Another candidate who gets 42% marks gets 12 marks more than the minimum passing marks. Find the maximum marks of the test.
1. 50
2. 80
3. 100
4. 150

14. An explosive for firing a bullet or a rocket is:
1. Putsch
2. Prosody
3. Propellant
4. Pulmonary

15. Passport Sewa Diwas is celebrated on which day?
1. 12 March
2. 24 June
3. 18 May
4. 20 April

16. Date of launching of satellite 'Aryabhatta' is _____.
1. 7 June, 1979
2. 19 April, 1975
3. 19 June, 1953
4. 07 April, 1981

17. A. Normally, a hair allowed to grow uncut will last from two to six year
B. These harmones supress the activity of certain follicles on the scalp so that the life span of the hair that grows from them is reduced
C. But as boldness sets in, the hair in some of head falls out more often
D. The overall effects is that hair in those places gets thinner and shorter until it in reduced to fuzz
E. The exact genetic code that causes boldness and thinning still eludes researchers, but they know it is has something to do with make sex harmone called androgens
Choose the most appropriate answer from the options given below:
1. D, C, A, B, E
2. B, C, D, A, E
3. E. B. A, C, D
4. E. B. C. D. A

18. Which of the options below this sentence should replace it to make it grammatically correct:
My decision for buying an electric car was motivated by economical consideration.
1. My decision for buying an electric car was motivated by economic consideration
2. My decision to buy an electric car was motivated by economic consideration
3. My decision to buy an electric car was motivated by economical considerations
4. No correction

19. If a right circular cylinder a height 14cm is increased in a sphere of radius Sem then volume of the cylinder (in.$cm^3$)- (user $\pi = \frac{22}{7}$).
1. 110
2. 220
3. 440
4. 600

20. The giving statement is followed by three arguments. Decide which of the options is correct about the given arguments.
Statements: Should seniority be only criterion for promotion in MNC's?
Arguments
I. Yes, otherwise seniors will feel humiliated
II. Yes, seniors are more experienced and must be rewarded
III. No, it would be an injustice to those juniors who are more deserving and suitable for higher position
1. I and II
2. II and III
3. Only III
4. Only I

21. What should come in place of the questions mark?
11, 20, 38, 74 _____?
1. 146
2. 154
3. 128
4. 136

22. Match List I with List II Fill the blanks in List I with suitable prepositional phrases from List II

| LIST I | LIST II |
|---|---|
| A. I doubt if she got the job _____ | I. At the very least |
| B. They should give me my money back or _____ offer to exchange the shoes | II. On balance |
| C. I thought i understood it, but _____ I realized it was more complicated | III. On merit |
| D. I would say that, _____ the best thing is to do nothing for the moment | IV. On reflection |

Choose the most appropriate answer from the options given below:

1. A-III, B-IV, C-II, D-I
2. A-I, B-III, C-II, D-IV
3. A-III, B-I, C-IV, D-II
4. A-II, B-IV, C-III, D-I

23. If QUALITY is coded as 8313927, then GOVERNMENT is coded as:
1. 7645954551
2.7645954552
3. 7645954452
4. 8645954552

24. A certain sum fetched simple interest of ₹ 3200 at the rate of 6.25% per annum in 4 years. What is the sum?
1. ₹ 13000
2. ₹ 12800
3. ₹ 12500
4. ₹ 212000

25. A. The election commission of India has decided to increase the amount of security for Lok Sabha candidates from the present ₹10,000 to ₹ 225.000
B. The election commission of India has decided to increase the amount of security for Vidhan Sabha candidate from the present ₹ 5,000 to ₹ 15,000
C. As per election commission, the candidate who secure less than one-sixth of the valid votes caste lose their security deposit in an election
D. The house of the people elects its own presiding officers, called speaker and the depty speaker
Choose the correct answer from the options given below:
1. A and B only
2. A, C and D only
3. A, B and C only
4. A, B, C and D only

26. The line integral $\vec{V} = x^2\hat{\imath} - 2y\hat{\jmath} + z^2\hat{k}$ over the straight line path from the point (-1, 2, 3) to (2, 3, 5) is
1. $\frac{27}{15}$
2. $\frac{37}{15}$
3. $\frac{163}{4}$
4. $\frac{92}{3}$

27. Let $f\ (x)$ be defined on $[0, 3]$ by $f(x) = \begin{cases} x, if\ x\ is\ a\ rational\ number \\ 3 - x. if\ x\ is\ an\ irational\ number \end{cases}$ Then $f(x)$ is continuous in the interval at:
1. no point
2. all points
3.2 points

28. The general solution of $(D^2 + 6D + 9)y = \frac{e^{-3x}}{x^3}$, where $D = \frac{d}{dx}$ is
(given that $c_1$ and $c_2$ are arbitrary constants)
1. $y = (c_1 + c_2 x)e^{-3x} + \frac{e^{-3x}}{2x}$
2. $y = (c_1 + c_2 x)e^{3x} + \frac{e^{3x}}{2x}$
3. $y = (c_1 + c_2 x^2)e^{-3x} + \frac{e^{-3x}}{2}$
4. $y = (c_1 + c_2 x)e^{-3x} + \frac{e^{3x}}{2x}$

29. Which of the following are generators of the multiplicative group $\{(1,2,3,4,5,6), x_7)$ where $x_7$ denotes multiplication moduls 7?
1. 3 and 4
2. 3 and 5
3. 4 and 5
4. 3, 4 and 5

30. If A is symmetric real valued matrix of dimension 2022, then eigenvalues of A are
1. 1011 distinct pairs of complex conjugate numbers
2. 1011 pairs of complex conjugate numbers not necessarily distinct
3. 2022 distinct real values
4. 2022 real values not necessarily distinct

31. In a group G, if $a^5 = e, aba^{-1} = b^2$ for $ab \in G$ then $o(b)$ is equal to:
1. 30
2. 32
3. 31
4. 25

32. The point $(-1, 2, 7, 6)$ lies in which of the following half spaces corresponding to hyperplane $2x_1 + 3x_2 + 4x_3 + 5x_4 = 6$
1. $2x_1 + 3x_2 + 4x_3 + 5x_4 < 6$
2. $2x_1 + 3x_2 + 4x_3 + 5x_4 > 6$
3. $2x_1 + 3x_2 + 4x_3 + 5x_4 > 62$
4. $2x_1 + 3x_2 + 4x_3 + 5x_4 > 62$

33. The solution of the differential equation
$\{x^4 + 6x^2 + 2(x + y)\}dx - xdy = 0$
subject to the condition $y(1) = 0$ is
1. $2y(x) = x^2 + x^4(6\log|x| - 3) + 4x$
2. $y(x) = \frac{1}{2}[x^2 + x^4\,(12\log|x| + 3) + 4x]$
3. $y(x) = x^4 + x^2\,(12\log|x| + 3) - 4x$
4. $2y(x) = x^4 + x^2(12\log|x| + 3) - 4x$

34. If $x^2\frac{d^2y}{dx^2} - 2x\frac{dy}{dx} - 4y = x^4$, then particular integral (P.I) of the given differential equation is

1. $\frac{xe^{4x}}{5}$
2. $\frac{1}{5}\ x^4 \log x$
3. $\frac{xe^{5x}}{4}$
4. $\frac{1}{4}\ x^5 \log x$

35. The equation $(2x + y + 1)dx + (x + 2y + 1)dy = 0$ represents a family of:
1. circles
2. parabolas
3. ellipses
4. hyperbolas

36. The extreme points of the set $\{(x, y); |x| \leq 2, |y| \leq 2\}$ are
1. (0, 0), (2, 2)
2. (1, 1), (2, 2), (-1, -1), (-2, -2)
3. (1, 1), (-1, 1), (-1, -1), (1, -1)
4. (2, 2), (-2, 2), (-2,-2), (2,-2)

37. With the help of suitable transform of the independent variable, the differential equation $x\frac{d^2y}{dx^2} + \frac{2dy}{dx} = 6x + \frac{1}{x}$ reduces to the form:
1. $\frac{d^2y}{dt^2} + 2\frac{dy}{dt} = 6e^{2t} + 1$
2. $\frac{d^2y}{dt^2} + \frac{dy}{dt} = 6e^{2t} + 1$
3. $\frac{d^2y}{dt^2} = 6e^{2t} + \log t$
4. $\frac{d^2y}{dt^2} + 6e^t + t$

38. The surface area of the sphere $x^2 + y^2 + z^2 = 9$ lying inside the cylinder $x^2 + y^2 = 3y$ is
1. $18\ (\pi + 2)$
2. $18\ (\pi - 2)$
3. $18\ (\pi - 4)$
4. $18\ (\pi + 4)$

39. The value of the dot product of the eigenvectors corresponding to any pair of different eigen values of a $4 \times 4$ symmetric positive definite matrix
1. 0
2. 1
3. 2
4. 4

40. If $f(x)$ satisfies the conditions of Rolle's theorem in [1, 2] and $f(x)$ is continuous in [1, 2], then $\int_1^2 f'(x)\, dx$ is equal to
1. 4
2. 0

3. 1
4. 2

41. Let $f(z) = u + iv$ be an analytic function, where $u = x^3 - 3xy^2 + 3x^2 - 3y^2$, then the imaginary part $v$ of $f(z)$ is
1. $3x^2y + 6xy - y^3 + c$
2. $3x^2y + 6xy + y^3 + c$
3. $x^2y + 6xy - y^3 + c$
4. $3x^2y - 6xy - y^3 + c$

42. If $f: \mathbb{R}^2 \to \mathbb{R}^2$ is a function defined as $f(x,y) = \begin{cases} \frac{x}{\sqrt{x^2+y^2}}, & x \neq, y \neq 0 \\ 2, & x = 0, y = 0 \end{cases}$ then, which of the following is correct?
1. $f(x,y)$ is continuous at origin.
2. $f(x,y)$ is differentiable at origin.
3. $\lim_{(x,y)\to(0,0)} f(x,y)$ exists and is equal to 2.
4. $f(x,y)$ is not continuous at origin.

43. The value of $\int_C \frac{\sin \pi z^2 + \cos \pi z^2}{(z-1)(z-2)} dz$, where $C$ is the circle $|z| = 3$ is
1. $4\pi i$
2. $8\pi i$
3. $2\pi i$
4. $\pi i$

44. Which of the following statement is not correct?
1. If A and B are non-singular matrices, then (AB) is also a non-singular matrix.
2. If AB = AC and A is non-singular matrix, then B = C.
3. The inverse of a non-singular symmetric matrix is also a symmetric matrix.
4. If A and B are symmetric matrices, then (AB-BA) is not a skew-symmetric matrix.

45. Which one of the following is not correct?
1. The set of limit points of a bounded sequence is bounded.
2. A bounded sequence with a unique limit point is convergent
3. The limit points of the sequence $\langle 2 + (-1)^n \rangle$ are 1 and 2.
4. The limit points of the sequence $\langle (-1)^n \rangle$ are-1 and 1.

46. A rectangular box open at the top is to have volume of 32 cubic feets. The minimum outer surface area of the box is
1.32 sq.ft
2. 46 sq.ft
3.44 sq.ft
4.48 sq.ft

47. Which one of the following statements is wrong.
1. The centre of a group G is a subgroup of G.
2. The union of two subgroups is always a subgroup.
3. If G is a finite group and H is a subgroup of G then o(H) divides o(G).
4. HK is a subgroup of G iff HK = KH.

48. Which of the following set(s) is/are convex set(s)?
A. $\{(x, y): xy \leq 1, x \geq 0, y > +0\}$
B. $\{(x, y): x^2 - 3 > -y^2, x, y \geq 0\}$
C. $\{(x, y): y^2 \leq 4x, x \geq 0, y \geq 0\}$
D. $\{(x, y): x^2 + y^2 \leq 4\}$
Choose the most appropriate answer from the options given below:
1. A and B only
2. A and C only
3. B and C only
4. C and D only

49. Let U and Ware distinct 4-dimensional subspaces of a vector space V of dimension 6. Consider the following statements:
A. The dimension of $U \cap W$ is either 2 or 3.
B. The dimension of $U + W$ is either 5 or 6.
C. The dimension of $U \cap W$ is always greater than 4.
D. The dimension of $U + W$ is always greater than 4.
Choose the correct answer from the options given below:
1. A, B and D only
2. A, B and C only
3. B, C and D only
4. C and D only

50. Consider the linear mapping $F: \mathbb{R}^2 \to \mathbb{R}^2$ defined by $F(x, y) = (3x + 4y, 2x - 5y)$ and following bases of $\mathbb{R}^2$:
$E = \{e_1, e_2\} = \{(1,0), (0,1)\}$ and $S = \{u_1, u_2\} = \{(1,2), (2,3)\}$. Then the matrix A representing F relative to the basis E is:
1. $\begin{bmatrix} 3 & 4 \\ 2 & -5 \end{bmatrix}$
2. $\begin{bmatrix} 3 & -5 \\ 4 & 3 \end{bmatrix}$
3. $\begin{bmatrix} 3 & 0 \\ 1 & -5 \end{bmatrix}$
4. $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$

51. The area of surface of solid generated by the revolution of line segment y = 2x from x = 0 to x = 2 about x-axis is equal to:
1. $\pi\sqrt{5}$
2. $2\pi\sqrt{5}$

3. $4\pi\sqrt{5}$
4. $8\pi\sqrt{5}$

52. If $\vec{r} = x_1\hat{a}_{x_1} + x_2\hat{a}_{x_2} + x_3\,\hat{a}_{x_3}$ and $|\vec{r}| = r$, then $div\left(r^2\nabla(\ln r)\right)$ is
1. 0
2. 3
3. $r$
4. $r^2$

53. If $f$ is twice differentiable function such that $f''(x) = -f(x)$ and $f'(x) = g(x), h(x) = [f(x)]^2 + [g(x)]^2$ and $h(5) = 11,$ then $h(10) =$
1. 22
2. 11
3. 15
4. 21

54. The positive term series $\sum_{n=1}^{\infty}\frac{1}{n^p}$ is convergent if
1. $p > 0$
2. $p\ > 1$
3. $p < 1$
4. $p \geq 1$

55. The value of surface integral $\iint_S\left(9x\,\hat{\imath} - 2y\hat{\jmath} - z\hat{k}\right)\cdot\hat{n}\,dS$ over the surface $S$ of the sphere $x^2 + y^2 + z^2 = 9$ where $\hat{n}$ is the unit outward normal to surface element $dS$ is:
1. $\frac{24}{3}\pi$
2. $\frac{216}{3}\pi$
3. $216\,\pi$
4. $24\,\pi$

56. The value of $\lim_{n\to\infty}\left[\frac{2}{1}\left(\frac{3}{2}\right)^2\left(\frac{4}{3}\right)^3\ldots\left(\frac{n+1}{n}\right)^n\right]^{1/n}$ is
1. 1
2. 0
3. $e$
4. $\frac{1}{e}$

57. Which one of the following rings is an integral domain?
1. $Z_{100}$
2. $Z_{102}$
3. $Z_{113}$
4. $Z_{153}$

58. The solution of the Linear Programming Problem

maximize $Z = 107x + y$
subject to constraints $x + y \leq 2$
$-3x + y \geq 3$
$x, y \geq 0$ is
1. 0
2. 2
3. 4
4. No solution

59. To evaluate the double integral $\int_0^8 \left( \int_{\frac{y}{2}}^{\left(\frac{y}{2}\right)+1} \left(\frac{2x-y}{2}\right) dx \right) dy$, we make the substitution $u = \frac{2x-y}{2}$ and $v = y/2$. The integral will reduce to
1. $\int_0^4 \left( \int_0^2 2udu \right) dv$
2. $\int_0^4 \left( \int_0^1 2udu \right) dv$
3. $\int_0^4 \left( \int_0^1 udu \right) dv$
4. $\int_0^4 \left( \int_0^{21} 2udu \right) dv$

60. Let A and B be $2 \times 2$ matrices, then which of the following is correct?
1. det(A+B) + det(A-B) = 2 det(A) + 2 det(B)
2. det(A+B) + det(A-B) = det(A) + det(B)
3. det(A+B) + det(A-B) = det(A) - det(B)
4. det(A+B) + det(A-B) = 2 det(A) - 2 det(B)

61. If $\lambda_1, \lambda_2, \lambda_3$ are the eigen values of the matrix $\begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & 6 \\ -1 & -2 & 0 \end{bmatrix}$, then $\lambda_1^2 + \lambda_2^2 + \lambda_3^2$ is equal to
1. 45
2. 40
3. 34
4. 43

62. The natural domain of definition of the function $f(z) = \frac{1}{1-|z|^2}$ is _____.
1. whole complex plane
2. whole complex plane excluding the points which lie on the unit circle $x^2 + y^2 = 1$.
3. complex plane excluding the point $z = 0$.
4. whole complex plane excluding the point $z = \frac{1}{2}$

63. The volume generated by the revolution of the cardiod $r = a(1 - \cos\theta)$ about x-axis is
1. $\frac{8\pi a^3}{3}$
2. $8\pi a^3$
3. $\frac{4\pi a^3}{3}$
4. $4\pi a^3$

64. The general solution of differential equation $\frac{d^2y}{dx^2} + 9y = \sin^3 x$ is
(given that $c_1$ and $c_2$ are arbitrary constants)
1. $y = c_1 \cos(3x + c_2) + \frac{1}{24}\sin x - \sin 3x$
2. $y = c_1\, e^{3x} + c_2\, e^{-3x} + \frac{1}{32}\sin x + \frac{1}{2}\cos 3x$
3. $y = c_1 + c_2\, xe^{3x} + 2\sin x - \frac{5}{13}\sin 3x$
4. $y = c_1 \sin(3x + c_2) + \frac{3}{32}\sin x + \frac{x}{24}\cos 3x$

65. Let $f: \mathbb{R} \to \mathbb{R}$ be such that $f(1) = 3$ and $f'(1) = 6$. Then $\lim_{x\to 0}\left(\frac{f(1+x)}{f(1)}\right)^{1/x}$ equals
1. $e^{1/2}$
2. $e^2$
3. $e^3$
4. 1

66. The matrix $P$ is the inverse of a matrix $Q$. If I denotes the identity matrix, which one of the following options is correct?
1. $PQ = I\ but\ QP \neq 1$
2. $QP = I$ but $QP \neq I$
3. $PQ = I$ and $QP = I$
4. $PQ - QP = I$

67. Evaluate the integral $\oint_C \frac{dz}{(z^2+4)^2}, C: |z - i| = 2$
1. $\pi i/4$
2. $\pi i/16$
3. $\pi/16$
4. $-\pi i/4$

68. If $\phi(z) = c_0 + c_1 z^{-1}$, then $\oint_{|z|=1} \frac{1+\phi(z)}{z} dz$ is
1. $2\pi c_1$
2. $2\pi(1 + c_0)$
3. $2\pi i c_1$
4. $2\pi i\ (1 + c_0)$

69. The minimum distance of the point $(3,4,12)$ from the sphere $x^2 + y^2 + z^2 = 1$ is
1. 14
2. 16
3. 12
4. 10

70. For what value(s) of $k$ the set of vectors $\{(1, k, 5), (1, -3,2), (2, -1,1)\}$ form a basis in $\mathbb{R}^3$?
1. $k \neq \frac{-10}{3}$

2. $k = -8$
3. $k \neq 8$
4. $k \neq -8$

71. The solution of $\left(x^2 - \sqrt{2}y\right)dx + \left(y^2 - \sqrt{2}x\right)dy = 0$ is given by
1. $x^3 - \sqrt{2}xy + y^3 = c$, where c is and arbitrary constant
2. $x^3 - 3\sqrt{2}xy + y^3 = c$, where c is and arbitrary constant
3. $x^3 + 3\sqrt{2}xy + y^3 = c$, where c is and arbitrary constant
4. $3x^3 - \sqrt{2}xy + 3y^3 = c$, where c is and arbitrary constant

72. If the solution of $x\frac{dy}{dx} + y = x^3y^6$ is $\frac{1}{y^\alpha x^\beta} = \frac{\gamma}{2x^2} + C$, then value of $\alpha + \beta + \gamma$ is
1. 5
2. 10
3. 15
4. 20

73. If the matrices $\begin{pmatrix} 1 & 0 \\ 0 & 0 \end{pmatrix}, \begin{pmatrix} -1 & 0 \\ 0 & 0 \end{pmatrix}, \begin{pmatrix} i & 0 \\ 0 & 0 \end{pmatrix}$ and $\begin{pmatrix} -i & 0 \\ 0 & 0 \end{pmatrix}$ form a group with respect to matrix multiplication, then which one of the following statements about the groups, thus formed is correct?
1. The group has no element of order 4.
2. the group has no element of order 3.
3. The group in non-abelian.
4. $\begin{pmatrix} -1 & 0 \\ 0 & 0 \end{pmatrix}$ is its own inverse.

74. The integrating factor of the differential equation $\frac{dy}{dx} = \frac{x^3+y^3}{xy^2}$ is
1. $\frac{1}{x^4}$
2. $\frac{1}{x^3}$
3. $\frac{1}{x^2}$
4. $\frac{1}{x}$

75. The function $f(z)$ defined by $f(z) = \begin{cases} \frac{Re(z)}{z}, & z \neq 0 \\ 0, & z = 0 \end{cases}$ then which one of the following is true?
1. $\lim_{z \to 0} f(z)$ exists
2. $f(z)$ is continuous at $z = 0$
3. $f(z)$ is differentiable everywhere
4. $f(z)$ is not continuous at $z = 0$

76. if $W$ is a subspace of $\mathbb{R}^3$, where $W = \{(a, b, c): a + b + c = 0\}$, then $\dim W$ is equal to
1. 2
2. 3
3. 1

4. 0

77. The work done by the force $\vec{F} = (x^2 - y^2)\,\hat{\imath} + (x + y)\,\hat{\jmath}$ in moving a particle along the closed path $C$ containing the curves $x + y = 0, x^2 - y^2 = 16$ and $u = x$ is the first and fourth quadrant is
1. $\frac{52}{3}$ units
2. $52\,\pi - 94$ units
3. $52\,\pi - 96$ units
4. $96\,\pi - 52$ units

78. The sequence $\langle\frac{(-1)^n}{n}\rangle$ is
1. oscillatory sequence
2. divergent sequence
3. either Cauchy or convergent sequence
4. both Cauchy and convergent

79. A scalar potential $\Psi$ has the gradient defined as $\nabla\Psi = yz\,\hat{\imath} + xz\,\hat{\jmath} + xy\hat{k}$. The value of the integral $\int_C \nabla\Psi \cdot d\,\vec{r}$ on the curve $\vec{r} = x\,\hat{\imath} + y\,\hat{\jmath} + z\hat{k}$, where curve $C: x = t, y = t^2, z = 3r^2\ (1 \le t < +3)$ is:
1. 0
2. 1
3. 242
4. 726

80. The line integral of function $F = yz\,\hat{\imath}$, in the counter clockwise direction, along the circle $x^2 + y^2 = 1$ at $z = 1$ is
1. $-2\pi$
2. $-\pi$
3. $\pi$
4. $2\pi$

81. if $P(x)$ is a polynomial of degree 10 with leading coefficient as 11 and having $(x - 1), (x - 2), (x - 3) \ldots (x - 10)$ as factor, then the coefficient of $x^9$ in $P(x)$ is
1. – 55
2. 605
3. – 605
4. 55

82. the all value of $z$, such that
$\sqrt{2}\sin z = \cosh\beta + i\sin\hbar\,\beta$, where $\beta$ is real, are
1. $z = (2n + 1)\frac{\pi}{2} + (-1)^n\left(\frac{\pi}{4} + i\beta\right), n = 0, \pm1, \pm2, \ldots.$
2. $z = n\pi - (-1)^n\left(\frac{3\pi}{4} + i\beta\right), n = 0, \pm1, \pm2, \ldots.$
3. $z = n\pi + (-1)^n\left(\frac{\pi}{4} + i\beta\right), n = 0, \pm1, \pm2, \ldots.$

4. $z = (2n+1)\frac{\pi}{2} + (-1)^n \left(\frac{\pi}{2} + i\beta\right), n = 0, \pm 1, \pm 2, \ldots.$

83. If $f(z) = \frac{1}{z^2-3z+2}$ is expanded in the region $|z| < 1$, then

1. $f(z) = \frac{1}{2} + \frac{3z}{4} + \frac{7}{8}z^2 + \frac{15}{16}z^3 + \cdots.$
2. $f(z) = \frac{1}{2} + \frac{4}{3}z + \frac{8}{7}z^2 + \frac{16}{15}z^3 + \cdots.$
3. $f(z) = \frac{1}{2} + \frac{3z}{4} + \frac{7}{9}z^2 + \frac{15}{19}z^3 + \cdots.$
4. $f(z) = \frac{1}{2} + \frac{3z}{4} + \frac{6}{7}z^2 + \frac{15}{11}z^3 + \cdots$

84. If $u = \cos^{-1}\left(\frac{x+y}{\sqrt{x}+\sqrt{y}}\right)$, then the value of $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ is

1. $\frac{1}{2}\cot u$
2. $-\frac{1}{2}\cot u$
3. $-\frac{1}{2}\tan u$
4. $\frac{1}{2}\tan u$

85. Let $f: G \to H$ be a group homomorphism from group $G$ into group $H$ with kernel $K$. If the order of $G, H$ and $K$ are $50$, 25 and 10 respectively then the order of $f(G)$ is

1. 2
2. 5
3. 10
4. 25

86. In the neighbourhood of $z = 1$, the function $f(z)$ has a power series expansion of the form $f(z) = 1 + (1-z) + (1-z)^2 + \cdots$ then $f(z)$ is

1. $\frac{1}{z}$
2. $\frac{-1}{z-2}$
3. $\frac{1}{2z-1}$
4. $\frac{z-1}{z+1}$

87. Which one of the following is wrong?

1. The set $Z$ of integers forms a group with respect to the usual addition of integers.
2. Let $G$ be the set $\{1, -1\}$. Then it forms a group under multiplication
3. Set of all non-zero complex numbers forms a group under multiplication.
4. the set $\mathbb{Q}$ of rational numbers forms a group with respect to the usual multiplication of rational numbers.

88. The solution $x_1 = 1, x_2 = 1, x_3 = 0$ and $z = 3$ to the system of equations

$x_1 + x_2 + x_3 = 2$

$x_1 + x_2 - x_3 = 2$

$x_1, x_2, x_3 \geq 0$

Which minimizes $z = x_1 + 2x_2 + 3x_3$ is

1. not feasible
2. not basic
3. feasible and basic
4. basic but not feasible

89. Let $S$ be piecewise smooth surface of the sphere $x^2 + y^2 + z^2 = 16, z > 0$, bounded by a simple closed curve $C$. Let $\vec{V} = (3x - y)\hat{\imath} - 2yz^2\,\hat{\jmath} - 2y^2\,z\,\hat{k}$ be a vector field which is continuous and has continuous first order partial derivatives in a domain contains $S$. Then the value of $\iint_S (\nabla \times \vec{V})\,.\,\hat{n}\,dA$, where $\hat{n}$ is the unit normal vector to $S$ is:
1. $\frac{16}{3}$
2. $48\pi - 3$
3. $64 + 3\pi$
4. $16\pi$

90. Which one of the following is a cyclic group?
1. The set of non-zero square matrices of order $2 \times 2$ over $\mathbb{R}$ under matrix multiplication
2. The group of roots (real or complex) of the equation $x^n - 1 = 0$, when $n$ is a natural number
3. The group $\mathbb{Q}/\{0\}$ of non-zero rationals under multiplication.
4. The group $\mathbb{Q}$ of rationals under addition.

91. the given series $\frac{x}{1.3} + \frac{x^2}{2.4} + \frac{x^3}{3.5} + \cdots, (x > 0)$ is convergent in the interval
1. $[1, \infty)$
2. $(1, \infty)$
3. $(0,1]$
4. $[0,1)$

92. Let $\vec{V}$ be a vector field and $f$ be a scalar point function, then curl $(f\,\vec{V})$ is equivalent to _____.
1. $(grad\ f) \cdot \vec{V} + f\ div\ (\vec{V})$
2. $(grad\ f) \times \vec{V} + f\ curl\ (\vec{V})$
3. $(grad\ f) \cdot (div\ \vec{V}) + curl\ (curl\ \vec{V})$
4. $grad\ [div\ \vec{V}] - f curl\ (\vec{V})$

93. The dimension of the general solution space $W$ of the homogeneous system
$x_1 + 2x_2 - 3x_3 + 2x_4 - 4x_5 = 0$
$2x_1 + 4x_2 - 5x_3 + x_4 - 6x_5 = 0$
$5x_1 + 10x_2 - 13x_3 + 4x_4 - 16\,x_5 = 0$
1. 2
2. 3
3. 4
4. 5

94. The order of the permutation $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 2 & 4 & 6 & 5 & 1 & 3 \end{pmatrix}$ is

1. 1
2. 2
3. 4
4. 8

95. Let $F: \mathbb{R}^3 \to \mathbb{R}^2$ be the linear map defined by $F(x, y, z) = (3x + 2y - 4z, x - 5y + 3z)$. The basis of $\mathbb{R}^3$ is $S$ and basis of $\mathbb{R}^2$ is $S$, where $S = \{(1,1,1), (1,1,0), (1,0,0)\}$ and $S' = \{(1,3), (2,5)\}$. Then the matrix of $F$ in the bases of $\mathbb{R}^3$ and $\mathbb{R}^2$ is

1. $\begin{bmatrix} -7 & -33 & -13 \\ 4 & 19 & 8 \end{bmatrix}$
2. $\begin{bmatrix} -7 & -33 & 8 \\ 3 & 15 & -13 \end{bmatrix}$
3. $\begin{bmatrix} -7 & 4 \\ -33 & 19 \\ 13 & 18 \end{bmatrix}$
4. $\begin{bmatrix} -7 & 13 & -33 \\ 4 & 18 & 9 \end{bmatrix}$

96. If $\vec{F} = y^2\hat{\imath} + xy\hat{\jmath} + xz\hat{k}$ and $C$ is the bounding curve of the hemisphere $x^2 + y^2 + z^2 = 9, z > 0$, oriented in the positive direction, then value of $\int_C \vec{F} \cdot d\vec{r}$ is

1. 0
2. 1
3. – 1
4. 2

97. If $A = \begin{bmatrix} 1 & 2 & 0 & -1 \\ 2 & 6 & -3 & -3 \\ 3 & 10 & -6 & -5 \end{bmatrix}$, then which one of the following is true?

1. Rank (A) = 4
2. Rank (A) = 3
3. Rank (A) = 2
4. Rank (A) = 1

98. If $\vec{F} = 2z\hat{\imath} - x\hat{\jmath} + y\hat{k}$ and $V$ is the region bounded by the surface $x = 0, y = 0, x = 2, y = 4, z = x^2, z = 2$, then value of $\iiint_V \vec{F}\, dV$ is

1. $\frac{32}{15}\left(3\hat{\jmath} + 5\hat{k}\right)$
2. $\frac{32}{15}\left(3\hat{\imath} + 5\hat{k}\right)$
3. $\frac{32}{15}\left(5\hat{\jmath} + 3\hat{k}\right)$
4. $\frac{32}{15}\left(3\hat{\imath} + 5\hat{\jmath}\right)$

99. The area bounded by the curves $y = x^2$ and $y = 4 - x^2$ is

1. $\frac{16\sqrt{2}}{3}$
2. $\frac{16}{3}$
3. $\frac{16\pi}{3}$

4. $\frac{8}{\sqrt{3}}$

100. The orthogonal trajectories of the family of curves $y = ax^3$ is

1. $2x^2 + 3y^2 = c$
2. $x^2 + 3y^2 = c$
3. $3x^2 + y^2 = c$
4. $x^2 + y^2 = c$