JSSC PGTTCE

Previous Year Paper
Mathematics 13 Mar 2018

**JHARKHAND STAFF SELECTION COMMISSION
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Subject:	PGT Mathematics

Section : **Mathematics**

Q.1 Consider 10 tosses of a fair dice. Let X_i denote the number of times digit 'i' appears. Find $\mathbb{P}(X_2 = 2 | X_1 = 2)$.

Question ID : **1945503080**

Ans ✗ 1. $C_2^{10}(1/6)^2(5/6)^8$

✓ 2. $C_2^8(1/5)^2(4/5)^6$

✗ 3. $C_2^8(1/6)^2(5/6)^6$

✗ 4. $(1/6)^2$

Q.2 We have $\mathbb{P}(X = x, Y = y) = 1/9$ for all $x, y \in \{1, 2, 3\}$. Find $\mathbb{P}(X > Y)$.

Question ID : **1945503083**

Ans ✗ 1. 0

✓ 2. $1/3$

✗ 3. 1

✗ 4. $1/2$

Q.3 Let f & g be the two real-valued functions defined on $[a, b]$ and $h(x) = max(f(x), g(x))\ for\ x\ \varepsilon\ [a, b]$. Which of the below is true?

Question ID : **1945503029**

Ans ✗ 1.
If f & g are differentiable, then so is h, as well as if f & g are convex, then h is also convex

✓ 2. If f & g are convex, then h is also convex

✗ 3. If f & g are differentiable, then so is h

✗ 4. If f & g are linear then h is also linear

Q.4 A block of concrete weighs 100 kg in air and weighs 60 kg when immersed in water. Then the average specific weight of the block is:

Question ID : **1945503150**

Ans ✗ 1. $3.2\ ton/m^3$

✓ 2. $2.5\ ton/m^3$

✗ 3. $2.2\ ton/m^3$

✗ 4. $2.1\ ton/m^3$

Q.5 If the stream function is given by $\psi = 6x + 12y$, then the speed of flow is given by:

Question ID : **1945503163**

Ans ✓ 1. $\sqrt{180}\ ms^{-1}$

✗ 2. $\sqrt{170}\ ms^{-1}$

✗ 3. $3\sqrt{2}\ ms^{-1}$

✗ 4. $\sqrt{0.5}\ ms^{-1}$

Q.6

The continuity equation in Cartesian coordinate is: (where the symbols used have their usual meanings)

Question ID : **1945503162**

Ans

✗ 1. $\dfrac{\partial \rho}{\partial x} + \dfrac{\partial (\rho \mu)}{\partial t} + \dfrac{\partial (\rho v)}{\partial y} + \dfrac{\partial (\rho w)}{\partial z} = 0$

✗ 2. $\dfrac{\partial^2 \rho}{\partial t^2} + \dfrac{\partial^2 (\rho \mu)}{\partial x^2} + \dfrac{\partial^2 (\rho v)}{\partial y^2} + \dfrac{\partial^2 (\rho w)}{\partial z^2} = 0$

✗ 3. $\dfrac{\partial^2 \rho}{\partial t^2} + \dfrac{\partial (\rho \mu)}{\partial x} + \dfrac{\partial (\rho v)}{\partial y} + \dfrac{\partial (\rho w)}{\partial z} = 0$

✔ 4. $\dfrac{\partial \rho}{\partial t} + \dfrac{\partial (\rho \mu)}{\partial x} + \dfrac{\partial (\rho v)}{\partial y} + \dfrac{\partial (\rho w)}{\partial z} = 0$

Q.7 Digital circuit can be made by the repeated use of which gate?

Question ID : **1945503104**

Ans

✗ 1. OR

✗ 2. None of the given options

✗ 3. NOT

✔ 4. NAND

Q.8 The Cartesian equation of common catenary is:

Question ID : **1945503145**

Ans

✗ 1. $y = c\,sinh\dfrac{x}{c}$

✔ 2. $y = c\,cosh\dfrac{x}{c}$

✗ 3. $y = c\,coth\dfrac{x}{c}$

✗ 4. $y = c\,tanh\dfrac{x}{c}$

Q.9 For the flow of a viscous Newtonian fluid between two parallel plates located at $y = 0$ and $y = h$, the upper plane is moving with velocity 'U'. The flow field is:

Question ID : **1945503161**

Ans

✔ 1. $\mu(y) = \dfrac{U\,y}{h}$

✗ 2. $\mu(y) = \dfrac{U\,y}{4h}$

✗ 3. $\mu(y) = \dfrac{U\,(y)}{2h}$

✗ 4. $\mu(y) = \dfrac{U\,y}{3h}$

Q.10 The orthogonal trajectories on the sphere $x^2 + y^2 + z^2 = 1$ upon its intersection with the family of planes $z = k, -1 \le k \le 1$ are given by:

Question ID : **1945503127**

Ans

✗ 1. $|y| = c|x|$ and $x^2 + y^2 - z^2 = 1$

✗ 2. $|y| = c|z|$ and $x^2 + y^2 + z^2 = 1$

✗ 3. $|z| = c|x|$ and $x^2 + y^2 - z^2 = 1$

✔ 4. $|y| = c|x|$ and $x^2 + y^2 + z^2 = 1$

Q.11 Find the rectangular coordinate of the point with cylindrical coordinate $(2, 2\pi/3, 1)$.

Question ID : **1945503085**

Ans

✔ 1. $(-1, \sqrt{3}, 1)$

✘ 2. $(2, \sqrt{3}, -2)$

✘ 3. $(1, \sqrt{3}, 0)$

✘ 4. $(1, \sqrt{3}, -1)$

Q.12 In a graph, the number of vertices with odd degrees is always:

Question ID : 1945503035

Ans ✘ 1. Odd

✘ 2. Zero

✔ 3. Even

✘ 4. Cannot be determined

Q.13 If every point of G has even degree, then G is a:

Question ID : 1945503037

Ans ✘ 1. Planar Graph

✘ 2. Tree

✔ 3. Eulerian Graph

✘ 4. Pie Chart

Q.14 A solid homogeneous cone of height 'h' and semi-vertical angle α oscillates about a diameter of its base. Then the length of the simple equivalent pendulum is:

Question ID : 1945503154

Ans

✘ 1. $\dfrac{h}{5}(2 + 5\tan^2\alpha)$

✔ 2. $\dfrac{h}{5}(2 + 3\tan^2\alpha)$

✘ 3. $\dfrac{h}{3}(2 + 3\tan^2\alpha)$

✘ 4. $\dfrac{h}{2}(2 + 5\tan^2\alpha)$

Q.15 Which of the following statements is INCORRECT?

Question ID : 1945503057

Ans ✘ 1.

The composite of two continuous functions is also continuous.

✔ 2.

Let $f(x + iy) = u(x,y) + iv(x,y)$. If u and v both have continuos partial derivatives with respect to x and y at point (x_0, y_0), then f is also differentiable at point (x_0, y_0).

✘ 3.

If f is analytic at all points interior to and on a simple closed contour C, then $\int f(z)dz$ over C = 0.

✘ 4.

If f is a continuous function defined on domain D, then $\int f(z)d(z)$ over $(z1, z2)$, where $z1, z2$ lie in D, is the same along all contours connecting $z1$ and $z2$ and lying entirely in D.

Q.16 Find the directional derivative of $D_u f(x, y)$ at the point $(x, y) = (1, 2)$, where $f(x, y) = x^3 - 3xy + 4y^2$ and **u** is the unit vector in the direction $\theta = \pi/6$.

Question ID : 1945503090

Ans

✔ 1. $\dfrac{13 - 3\sqrt{3}}{2}$

✘ 2. 10

✘ 3. $3\sqrt{3}$

✘ 4. 0

Q.17 The integrating factor for the differential equation $y(xy + 2x^2y^2)dx + x(xy - x^2y^2)dy = 0$ is:

Ans

✗ 1. $\dfrac{1}{xy}$

Question ID : 1945503116

✗ 2. $\dfrac{1}{x^2 y^2}$

✓ 3. $\dfrac{1}{3x^3 y^3}$

✗ 4. $\dfrac{1}{xy^3}$

Q.18 Circumference of a cyclic graph is defined as:

Question ID : 1945503036

Ans ✗ 1. Twice the sum of its total degree

✓ 2. Length of the longest cycle

✗ 3. Length of the shortest cycle

✗ 4. Thrice the sum of its total degree

Q.19 If $x(t)$ denotes the number of susceptibles and $y(t)$ denotes the number of infectives at any time t, in a homogeneous group of $(n + 1)$ individuals, the simple epidemic model without removal is given by the equation: (where $\beta > 0$ is the contact rate)

Question ID : 1945503135

Ans

✗ 1. $\dfrac{dx}{dt} = \beta x(n - 1 + x)$

✓ 2. $\dfrac{dx}{dt} = -\beta x(n + 1 - x)$

✗ 3. $\dfrac{dx}{dt} = -\beta x(n - 1 + x)$

✗ 4. $\dfrac{dx}{dt} = \beta x(n + 1 - x)$

Q.20 The steady state solution $\mu(x, t) = \mu_s(x)$ of heat equation $\mu_t = a^2 \mu_{xx}$ satisfying the conditions $\mu(a, t) = -1, \mu(2, t) = 1$ is:

Question ID : 1945503133

Ans ✗ 1. $\mu_s(x) = 1 - x$

✓ 2. $\mu_s(x) = -1 + x$

✗ 3. $\mu_s(x) = -1 + 3x$

✗ 4. $\mu_s(x) = 1 + 2x$

Q.21 Which one of the following statements is false?

Question ID : 1945503109

Ans ✗ 1.

A field $(F, +, \cdot)$ always has a multiplicative identity.

✓ 2.

$M_{n \times n}(R)$, the space of all $n \times n$ real-valued matrices under the operation of matrix addition and multiplication forms an integral domain.

✗ 3.

The set of complex numbers forms an algebraically closed field.

✗ 4.

For a group $(G, \cdot)$ identity element is always unique.

Q.22 Consider the following real-valued maps defined over the vector space of 2×2 real-valued matrices. Which one of the following is not linear?

Question ID : 1945503070

Ans

✗ 1. $T(A) = tr(A)$

✗ 2. $T(A) = a_{11}$

✗ 3. $T(A) = A^t$

✓ 4. $T(A) = \det(A)$

Q.23 The size of a population of small rodents was recorded as follows:

Month	0	2	6	10
Population	2	5	20	109

The growth rate as a percentage per month and the population at the end of 12 months are respectively:

Question ID : **1945503142**

Ans ✗ 1. 37.2428% and 234

✗ 2. 38.2428% and 235

✗ 3. 32.2428% and 131

✓ 4. 39.2428% and 231

Q.24 Consider variable μ that satisfies the equation $\frac{d^2\mu}{d\theta^2} + \mu = 2k\cos\theta$ and the conditions:

(i) μ has some value when $\theta = \pm\frac{\pi}{2}$

(ii) $\int_0^{\frac{\pi}{2}} \mu d\theta = 0$

The value of this variable μ is given by:
(for arbitrary constant 'k')

Question ID : **1945503123**

Ans ✗ 1. $\mu = k(\theta\sin\theta + \cos\theta)$

✗ 2. $\mu = k(\sin\theta + \theta\cos\theta)$

✓ 3. $\mu = k(\theta\sin\theta - \cos\theta)$

✗ 4. $\mu = k(\sin\theta - \theta\cos\theta)$

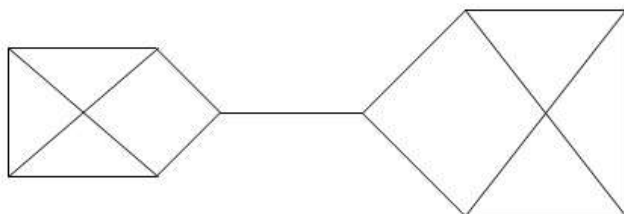**Q.25** Find the length of the arc of the circular helix with vector equations $r(t) = \cos t\mathbf{i} + \sin t\mathbf{j} + t\mathbf{k}$, from $(1,0,0)$ to $(1,0,2\pi)$.

Question ID : **1945503089**

Ans ✗ 1. $\sqrt{2}\pi$

✓ 2. $2\sqrt{2}\pi$

✗ 3. 1

✗ 4. π

Q.26 Select the correct statement with regard to the below graph.

Question ID : **1945503040**

Ans ✗ 1. G is a complete graph

✗ 2. G is a non-planar graph

✗ 3. G is an eulerian graph

✓ 4. G is a planar graph

Q.27 What is the number of edges present in a complete graph with n vertices?

Question ID : **1945503041**

Ans ✗ 1. $n(n-1)$

✗ 2. $n^2/2$

✗ 3. $n(n+1)/2$

✓ 4. $n(n-1)/2$

Q.28 Using Residue Theorem, evaluate the integral $\int (5z-2)/(z(z-1))\,dz$, over the contour $C : |z| = 2$.

Question ID : **1945503064**

Ans   ✗ 1. $6\pi i$

✓ 2. $10\pi i$

✗ 3. $5\pi i$

✗ 4. $8\pi i$

Q.29 For a viscous flow of a fluid through a pipe with a circular cross-section given by r = a gradient under the constant pressure $P = -\frac{\partial p}{\partial z}$, μ_z, μ_r and μ_θ are respectively:
(where the symbols used have their usual meaning.)

Question ID : **1945503160**

Ans   ✓ 1. $\dfrac{P}{4\mu}(a^2 - r^2), 0, 0$

✗ 2. $\dfrac{P}{2\mu}(a^2 + r^2), 0, 0$

✗ 3. $\dfrac{P}{\mu}(a^2 - r^2), 0, 0$

✗ 4. $\dfrac{P}{3\mu}(a^2 + r^2), 0, 0$

Q.30 Which of the following is NOT a purpose of a model from political science?

Question ID : **1945503136**

Ans   ✗ 1.
Providing insights into a general class of problems.

✓ 2.
Produce obvious directions for further study.

✗ 3. Forecast events or outcomes.

✗ 4.
Organizing empirical generalizations or known facts.

Q.31 The order and degree of the differential equation $x^2(dx)^2 + 2xy\,dx\,dy + y^2(dy)^2 - z^2(dz)^2 = 0$ are respectively:

Question ID : **1945503115**

Ans   ✗ 1. 1 and 1

✓ 2. 1 and 2

✗ 3. 2 and 2

✗ 4. 2 and 1

Q.32 Express in decimal the value of $100001 + 110111$.

Question ID : **1945503099**

Ans   ✗ 1. 78

✗ 2. 87

✓ 3. 88

✗ 4. 80

Q.33 Single species population model is given by the equation:
(where the symbols used have their usual meaning)

Question ID : **1945503137**

Ans   ✗ 1. $\dfrac{dN}{dt} = B(t)D(t) + D(t)N(t)$

✗ 2. $\dfrac{dN}{dt} = B(t)N(t) + D(t)N(t)$

✗ 3. $\dfrac{dN}{dt} = \dfrac{B(t)}{N(t)} + \dfrac{N(t)}{D(t)}$

✓ 4. $\dfrac{dN}{dt} = B(t)N(t) - D(t)N(t)$

Q.34 In a take-away food joint with single service counter, the customers are served on a first-come-first-serve basis. The arrival rate of customers follows Poisson distribution, while the expected service time follows exponential distribution. If 2 customers arrive every 10 minutes and 18 customers are served per hour, what is the expected number of customers in the joint at any given time?

Question ID : 1945503049

Ans ✓ 1. 2

✗ 2. 5

✗ 3. 9

✗ 4. 1

Q.35 The set of units in Z_{14} (under the usual operation modulo 14 addition and multiplication) is given by:

Question ID : 1945503110

Ans ✗ 1. Z_{14}

✗ 2. $\{1\}$

✓ 3. $\{1, 13, 3, 5, 11, 9\}$

✗ 4. $\{1, -1, 3, 5, 2, 7\}$

Q.36 Calculate $\lim (x^2 - 4)/(x^2 + 5x - 14)$ as $x -> 2$.

Question ID : 1945503030

Ans ✗ 1. Undefined

✗ 2. 2/7

✗ 3. 4/5

✓ 4. 4/9

Q.37 Which logic gate has the following truth table?

Question ID : 1945503100

A	B	C
0	0	0
0	1	1
1	0	1
1	1	1

Ans ✓ 1. OR with 2 inputs

✗ 2. NAND

✗ 3. AND with 2 inputs

✗ 4. NOR

Q.38 Which one of the following is a group?

Question ID : 1945503105

Ans ✗ 1.
The set of all 2 by 2 matrices under multiplication.

✗ 2.
$(R^+, \times)$ where $a \times b = \sqrt{ab}$ for all $a, b \in R^+$.

✓ 3.
$(C[0,1], \times)$ where $(f \times g)(x) = f(x)g(x)$. ($C[0,1]$ denotes the set of continuous functions defined over $[0,1]$).

✗ 4. The set of odd integers under addition.

Q.39 The moment of inertia of a uniform thin rod of mass 'M' and length 'L' about a perpendicular axis of rotation at its end is:

Ans

✗ 1. $\frac{1}{8}ML^2$

✗ 2. $\frac{1}{2}ML^2$

✓ 3. $\frac{1}{3}ML^2$

✗ 4. $\frac{1}{4}ML^2$

Question ID : **1945503158**

Q.40 For what value of m is the line $y = mx + 5$ tangent to the ellipse represented by $\frac{4x^2}{9} + \frac{y^2}{16} = 1$

Question ID : **1945503023**

Ans ✗ 1. 2

✓ 2. ±2

✗ 3. ±3

✗ 4. 3

Q.41 The binary equivalent of 57 is:

Question ID : **1945503101**

Ans ✗ 1. 101111

✓ 2. 111001

✗ 3. 111000

✗ 4. 101010

Q.42 Which of the following can be reduced to a Clairaut's equation?

Question ID : **1945503117**

Ans ✗ 1. $y' = e^x + e^y + y^2$

✗ 2. $y' = \sin x + \sin y$

✗ 3. $y = x^4 p - p^2 x$, where $p = \frac{dy}{dx}$

✓ 4. $y = 2xp + y^2 p^3$, where $p = \frac{dy}{dx}$

Q.43 The equation for finding the centre of pressure of a rocket is: (where $(C_{N\alpha})_n$ denotes the normal force on nose.)

Question ID : **1945503151**

Ans ✗ 1. $(C_{N\alpha})_n = 3$

✓ 2. $(C_{N\alpha})_n = 2$

✗ 3. $(C_{N\alpha})_n = 1$

✗ 4. $(C_{N\alpha})_n = 4$

Q.44 Which is called as the universal gate?

Question ID : **1945503102**

Ans ✗ 1. AND

✗ 2. OR

✓ 3. NAND

✗ 4. XNOR

Q.45 Evaluate $\int_c (x^4 \partial x + xy \partial y)$, where C is the triangular curve consisting of the line segments from $(0, 0)$ to $(1, 0)$, from $(1, 0)$ to $(0, 1)$ and from $(0, 1)$ to $(0, 0)$.

Question ID : **1945503094**

Ans ✗ 1. 0

✗ 2. 12

✔ 3. 1/6

✘ 4. 1

Q.46 If a function $f(z)$ defined on some domain D of the complex plane is differentiable on D, it is said to be:

Question ID : 1945503056

Ans

✔ 1. Analytic function

✘ 2. Non-singular function

✘ 3. Bounded function

✘ 4. Harmonic function

Q.47 Let $f(r\cos\omega + ir\sin\omega) = u(r, \omega) + iv(r, \omega)$. For f to be differentiable at (r, ω), Cauchy-Riemann equation states that:

Question ID : 1945503055

Ans

✘ 1. $U_r = -V_r/r, V_r = -U_\omega/r$

✔ 2. $U_r = V_\omega/r, V_r = -U_\omega/r$

✘ 3. $U_r = -V_\omega/r, V_\omega = -U_\omega/r$

✘ 4. $U_r = -V_\omega/r, V_r = -U_\omega/r$

Q.48 A solution to linear programming problem that satisfies all the constraints, except the non-negativity constraint, is referred to as:

Question ID : 1945503045

Ans

✘ 1. Feasible solution

✔ 2. Basic solution

✘ 3. Optimal solution

✘ 4. Basic feasible solution

Q.49 The equation of the characteristic curve of the one-parameter family $(x - a)^2 + (y - a)^2 + z^2 = 1$ is:

Question ID : 1945503126

Ans

✔ 1. $(x - y)^2 = 2(1 - z^2)$

✘ 2. $(x - y)^2 = 1 - z^2$

✘ 3. $(x - z)^2 = 2(1 - y^2)$

✘ 4. $(x - z)^2 = 1 - y^2$

Q.50 If C is a positively oriented simple closed contour within and on which function f is analytic, except for a finite number of singular points zk $(k = 1, 2, \dots n)$ interior to C, then Residue Theorem states that:

Question ID : 1945503058

Ans

✘ 1. $\int_c f(z)\, dz = e\pi i (\sum_k \text{Res } f(z_k)/k!)$

✔ 2. $\int_c f(z)\, dz = 2\pi i (\sum_k \text{Res } f(zk))$

✘ 3. $\int_c f(z)\, dz = 2\pi i (\sum_k \text{Res } f(z_k)/k!)$

✘ 4. $\int_c f(z)\, dz = (\sum_k \text{Res } f(z_k))$

Q.51 Consider 10 tosses of a biased coin with probability of obtaining head as 1/3. Let Y denote the total number of tails observed. Find $\mathbb{E}(5Y + 2)$.

Question ID : 1945503078

Ans

✘ 1. 10

✘ 2. 56/3

✔ 3. 106/3

✘ 4. 10/3

Q.52 A Graph G with p vertices $(p \geq 3)$ is Hamiltonian, if:

Question ID : 1945503042

Ans

✘ 1. For all points v in G, degree v < p/2

✔ 2. For all points v in G, degree v >= p/2

✘ 3. All points v in G have an even degree

✗ 4. All points in G have an odd degree

Q.53 If P and Q are two non-intersecting forces whose directions are perpendicular, then the ratio of distance of the central axis from their lines of action is represented as:

Question ID : 1945503148

Ans

✗ 1. $Q^2 : 2P^2$

✗ 2. $2P^2 : Q^2$

✓ 3. $Q^2 : P^2$

✗ 4. $P^2 : Q^2$

Q.54 Let C denote the boundary of circle with radius 3 around the centre $z_1 = 2 + i$. Calculate the integral $I = \int e^{az}/(z - 2 - i) \, dz$ over contour C.

Question ID : 1945503060

Ans

✗ 1. 0

✗ 2. $2\pi i \left(e^{a(2-i)} \right)$

✓ 3. $2\pi i \left(e^{a(2+i)} \right)$

✗ 4. $2\pi i \left(e^{a(2+2i)} \right)$

Q.55 The Cartesian equation of the surface $x = \mu \cos v, y = \mu \sin v, z = \mu \cot v$ is:

Question ID : 1945503125

Ans

✗ 1. $x^2 + z^2 = y^2 \tan v$

✗ 2. $x^2 + y^2 = z^2 \cot v$

✓ 3. $x^2 + y^2 = z^2 \tan^2 v$

✗ 4. $x^2 + z^2 = y^2 \cot v$

Q.56 Revolving the circular area of radius 'R' through 360° about the x-axis, a complete torus is generated. The distance between the centre of the circle and the x-axis is 'd'. Then the surface area of the torus is:

Question ID : 1945503157

Ans

✗ 1. $3\pi^2 Rd$

✓ 2. $4\pi^2 Rd$

✗ 3. $\pi^2 Rd$

✗ 4. $2\pi^2 Rd$

Q.57 The density of a r.v. X is given by:

$$f x(x) = \begin{cases} a + bx^2 & \text{for } x \in [0,1] \\ 0 & \text{otherwise} \end{cases}$$

Find (a, b) if $E(X)$ is 3/5.

Question ID : 1945503084

Ans

✗ 1. $(3/5, -3/5)$

✗ 2. $(3, -3)$

✗ 3. $(1, 2)$

✓ 4. $(3/5, 6/5)$

Q.58 In a take-away food joint with single service counter, the customers are served on a first-come-first-serve basis. The arrival rate of customers follows Poisson distribution, while the expected service time follows exponential distribution. If 2 customers arrive every 10 minutes and 18 customers are served per hour, what is the probability for an incoming customer to wait for more than 30 minutes before being served?

Question ID : 1945503050

Ans

✗ 1. $(2/3)e^{-4}$

✗ 2. $(2/3)e^{-2.5}$

✓ 3. $(2/3)e^{-3}$

✗ 4. $(2/3)e^{-2}$

Q.59 The number of Boolean functions that can be generated by n variables is:

Ans ✗ 1. 2^{n-1}

✗ 2. 2^n

✓ 3. 2^{2^n}

✗ 4. 2^{2n}

Q.60 Evaluate $\int_D xy\,\partial A$ where D is the region bounded by the line $y = x - 1$ and the curve $y^2 = 2x + 6$.

Ans ✗ 1. 100

✓ 2. 36

✗ 3. 10

✗ 4. 6

Q.61 The partial differential equation by eliminating the arbitrary function f from $z = e^{mx}f(x + y)$ is:

Ans ✓ 1. $p - q = mz$

✗ 2. $q - r = z$

✗ 3. $p - t = z$

✗ 4. $p + q = mz$

Q.62 Let A = {A1, A2, A3…..} be an infinite collection of closed sets. Which of the following is true?

Ans ✗ 1.

Arbitrary intersection of sets from A is open

✓ 2. Finite union of sets from A is closed

✗ 3. None of the options are true

✗ 4. Arbitrary union of sets from A is closed

Q.63 A is a square matrix with each row sum equal to 1. Which one of the following statements regarding the eigenvalues of A is always true?

Ans ✗ 1. 0 is an eigenvalue of A.

✓ 2. 1 is an eigenvalue of A.

✗ 3. Both 0 and 1 are eigenvalues of A.

✗ 4.

No statement can be made on eigenvalue of A based on given information.

Q.64 Let V represent the temperature (in °F) of an object in a room, whose temperature is kept at a constant 60°. If the object cools down from 100° to 90° in 10 minutes, how much more time (in minutes) will it take for its temperature to decrease to 80°?

Ans ✗ 1. 12.08

✗ 2. 15.09

✓ 3. 14.09

✗ 4. 13.09

Q.65 Which of the following statements is NOT correct?

Ans ✗ 1. Urban water uses involves transportation.

✗ 2. Urban water uses involves water supply.

✗ 3.

Urban water uses involves power generation.

✔ 4.
Urban water uses involves snow removal strategies.

Q.66 The logical expression $y = A + A^c B$ is equivalent to:

Question ID : **1945503097**

Ans ✘ 1. $y = A^c + B$

✔ 2. $y = A + B$

✘ 3. $y = AB$

✘ 4. $y = A^c B$

Q.67 Which one of the following statements is false?

Question ID : **1945503071**

Ans ✘ 1.

$C[0,1]$ denotes the space of all continuous functions. $T : C[0,1] \mapsto \mathbb{R}$ defined as $T(f) = 2f(1) + \int_0^1 f(s)\,ds$ is a linear functional.

✔ 2.

$\mathbb{M}_{2\times 3}(\mathbb{R})$, the space of all real-valued matrices is isomorphic to $\mathbb{R}^5$.

✘ 3.

Let $A, B : V \mapsto V$ be linear and I is the identity map. Then $AB = I$ implies that A and B are invertible.

✘ 4.

A linear transformation T is invertible if and only if T is one-one and onto.

Q.68 Which of the following is true?

Question ID : **1945503111**

Ans ✘ 1.

Every permutation can be written as a product of intersecting cycles.

✘ 2.

Every permutation can be written as a product of cycles of length 1.

✔ 3.

Every permutation can be written as a product of disjoint cycles.

✘ 4.

Every permutation can be written as a product of cycles that do not commute.

Q.69 Which type of graph is shown below?

Question ID : **1945503039**
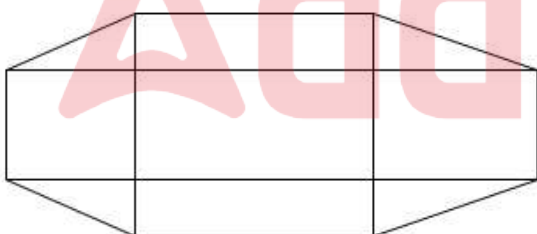
Ans ✘ 1. Eulerian Graph

✘ 2. Tree Graph

✔ 3. Bi-partite Graph

✘ 4. Complete Graph

Q.70 In a newly opened bank, customers arrive at the rate of 2 customers per hour and are serviced by a single teller counter in about 20 minutes. The bank has a newly implemented policy that there should be no more than 5% chance that a customer has to wait for more than 30 minutes in the queue before being served. How many additional teller counters should they open to meet the policy requirements?

Question ID : **1945503054**

Ans ✘ 1. 0 (the existing counter is sufficient)

✘ 2. 3

✔ 3. 1

✘ 4. 2

Q.71 The metacentric height of a rectangular boat $6 \times 6 \times 12$, a quarter portion of which is submerged in water, is:

Question ID : 1945503152

Ans ✗ 1. 1.5

✓ 2. 3.5

✗ 3. 4.5

✗ 4. 2.5

Q.72 For a tree with q lines, the number of vertices p equals:

Question ID : 1945503038

Ans ✗ 1. $2q$

✗ 2. q

✗ 3. $q + 2$

✓ 4. $q + 1$

Q.73 Let $f : [0, \infty]$ s.t. df/dx is monotonically increasing and $(0) = 0$. If $g(x) = f(x)/x$, then g is:

Question ID : 1945503033

Ans ✗ 1. Concave function

✗ 2. Convex function

✗ 3. Monotonically decreasing

✓ 4. Monotonically increasing

Q.74 Which one of the following group is cyclic?

Question ID : 1945503107

Ans ✗ 1. $(Q, +)$

✗ 2. $(Q^+, \cdot)$

✗ 3.

$GL_n(R)$ under the operation of matrix multiplication.

✓ 4.

$\{ \begin{pmatrix} 1 & n \\ 0 & 1 \end{pmatrix} : n \in Z \}$ under the operation of matrix multiplication.

Q.75 For a blood vessel of constant radius 'R', length 'L' and driving force $P = P_1 - P_2$, where P_1 and P_2 respectively denote the pressures at either end of length 'L' of the cylinder considered, the average flow is equal to half the maximum velocity and the resistance $\frac{P_1 - P_2}{V}$ is proportional to:

Question ID : 1945503141

Ans ✗ 1. $\dfrac{L}{R^3}$

✓ 2. $\dfrac{L}{R^4}$

✗ 3. $\dfrac{L}{P^2}$

✗ 4. $\dfrac{L}{R}$

Q.76 Obtain the dimension of the dual space for $\{(x, y, z) : x + 2y + 3z = 0\}$.

Question ID : 1945503068

Ans ✗ 1. 3

✓ 2. 2

✗ 3. 4

✗ 4. 1

Q.77 Which one of the following statements is false?

Question ID : 1945503066

Ans ✗ 1.

For any vector space, basis set gives a minimal spanning set.

✗ 2. Basis set for a vector space is not unique.

✗ 3.
Any set of vectors with null vector is linearly dependent.

✔ 4.
For any linear transformation $T : V \mapsto V$ and for any basis set $\{v_1, \ldots, v_k\}$ of V, the set $\{T(v_i) : 1 \le i \le k\}$ also gives a basis set.

Q.78 A cone with height 32 cm and radius 4 cm is filled with water. How many semi-hemispheric bowls of radius 2 cm can be fully filled using this water?

Question ID : 1945503019

Ans ✗ 1. 8

✗ 2. 64

✗ 3. 16

✔ 4. 32

Q.79 A forest can support a herd of 500 deers whose population has a linear growth rate of 20% per year. Then the number of deers that can be killed by hunting each year to maintain the herd size at 300 is:

Question ID : 1945503143

Ans ✗ 1. 28

✗ 2. 32

✔ 3. 24

✗ 4. 20

Q.80 If x and e^{-x} are two linearly independent solutions of the equation $(1+x)\frac{d^2y}{dx^2} + x\frac{dy}{dx} - y = (1+x)^2$, then by the method of variation of parameter, the particular integral is:

Question ID : 1945503124

Ans ✗ 1. $x + 1 - x^2$

✗ 2. $x^2 - 1 - e^x$

✔ 3. $x^2 + 1 - x$

✗ 4. $x + 1 - e^x$

Q.81 The function $sin(e^x)$, where $x > 0$:

Question ID : 1945503026

Ans ✔ 1. Is bounded but does not converge

✗ 2. Diverges to infinity as $x -> \infty$

✗ 3. Is strictly increasing but bounded

✗ 4.
Is bounded and converges to a real number as $x -> \infty$

Q.82 Below matrix gives the transportation cost of sending material from 3 depots to 5 final destinations. The storage capacity of the depots and the receiving capacity of final destination shops (represented as S1, S2, ...) is also given. Find the minimal transportation cost satisfying the constraints on storage depots and receiver shops.

Question ID : 1945503053

	S1	S2	S3	S4	S5	
Dep A	3	6	3	1	1	4
Dep B	2	4	3	2	7	5
Dep C	1	1	2	1	2	6
	2	2	3	4	4	

Ans ✔ 1. 23

✗ 2. 25

✗ 3. 20

✗ 4. 21

Q.83 Let $f(x)$ be a differentiable function on R such that $df/dx > 0$ for all x and $\lim f(x) -> 2$ as $x -> -\infty$. Which of the following is true?

Question ID : 1945503027

Ans ✔ 1. $f(3) > 2$

✗ 2. $f(3) >= 2$

✗ 3. $f(3) <= 2$

✗ 4. $f(3) = 2$

Q.84 Which one of the following is NOT a subspace?

Question ID : **1945503065**

Ans
- ✗ 1. $\{(x, 2x): x \in \mathbb{R}\}$ over $\mathbb{R}$.
- ✗ 2. $\mathbb{Q}$ over $\mathbb{Q}$.
- ✓ 3. $\{(x, y): x \times y = 0\}$ over $\mathbb{R}$.
- ✗ 4. $\{(x, y): 2x + 3y = 0\}$ over $\mathbb{R}$.

Q.85 The integral surface of $yp + xq - z = 0$ passing through the curve $z = x^3$, $y = 0$ is:

Question ID : **1945503130**

Ans
- ✓ 1. $z(1 + x^2 - y^2) = (x^2 - y^2)(x + y + z)$
- ✗ 2. $1 + x^2 - y^2 = (x^2 - y^2)(x + y + z)$
- ✗ 3. $z(1 - x^2 - y^2) = (x^2 - y^2)(x + y + z)$
- ✗ 4. $z(1 + x^2 - y^2) = (x^2 + y^2)(x + y + z)$

Q.86 The particular integral of the equation $(2D^2 - D')z = 10e^{x-3y}$ is:

Question ID : **1945503128**

Ans
- ✓ 1. $2e^{x-3y}$
- ✗ 2. e^{x-3y}
- ✗ 3. $2e^{x+3y}$
- ✗ 4. e^{x+3y}

Q.87 If at least one of the basic variables is zero in a basic feasible solution of LPP, the solution is said to be:

Question ID : **1945503047**

Ans
- ✗ 1. Optimal
- ✗ 2. Singular
- ✗ 3. Unbounded
- ✓ 4. Degenerate

Q.88 Compute $\int \cos(z/2) \, dz$, over $(0, \pi + 2i)$.

Question ID : **1945503061**

Ans
- ✓ 1. $e + 1/e$
- ✗ 2. $Sin(\pi/4)$
- ✗ 3. $2\pi i$
- ✗ 4. 0

Q.89 Find the focus of the below conic.
$x^2 + 19 - 8x - y = 0$

Question ID : **1945503016**

Ans
- ✓ 1. $(4, 3.25)$
- ✗ 2. $(2.75, 4)$
- ✗ 3. $(3.25, 4)$
- ✗ 4. $(4, 2.75)$

Q.90 Which one of the following is a correct statement?

Question ID : **1945503159**

Ans
- ✓ 1.
  Holonomic systems are systems for which all constraints are integrable into positional constraints.
- ✗ 2.
  Non-holonomic systems are systems where velocities and other derivatives of the position are not constraints.
- ✗ 3.
  Holonomic systems are systems for which all constraints are non-integrable into positional constraints.

✗ 4.
Non-holonomic systems are systems that have constraints that are integrable into positional constraints.

Q.91 In the simplex method, which variables are introduced to convert constraint conditions to equations?

Question ID : 1945503046

Ans ✗ 1. Feasible variables

✗ 2. Basic variables

✗ 3. Degenerate variables

✓ 4. Slack variables

Q.92 Consider an ellipse represented with following equation:

Question ID : 1945503017

$$\frac{x^2}{16} + \frac{y^2}{49} = 1$$

The length of the latus rectum of this ellipse is:

Ans ✓ 1. $\frac{49}{2}$

✗ 2. $\frac{49}{4}$

✗ 3. 49

✗ 4. $\frac{49}{16}$

Q.93 The integral curves of the equations $\frac{dx}{x^2(y^3-z^3)} = \frac{dy}{y^2(z^3-x^3)} = \frac{dz}{z^2(x^3-y^3)}$ are given by:

Where c_1 and c_2 are arbitrary constants.

Question ID : 1945503129

Ans ✗ 1.
$$x^2 + y^2 - z^2 = c_1 \text{ and } x^{-1} + y^{-1} - z^{-1} = c_2$$

✗ 2.
$$x^2 - y^2 + z^2 = c_1 \text{ and } x^{-1} - y^{-1} + z^{-1} = c_2$$

✗ 3.
$$x^2 - y^2 - z^2 = c_1 \text{ and } x^{-1} - y^{-1} - z^{-1} = c_2$$

✓ 4.
$$x^2 + y^2 + z^2 = c_1 \text{ and } x^{-1} + y^{-1} + z^{-1} = c_2$$

Q.94 In one dimensional equation of motion, Bernoulli's equation is given by:

(where $\frac{v^2}{2}$ is the kinetic energy, $\frac{p}{\rho}$ is flow energy and gz is potential energy, all per unit mass.)

Question ID : 1945503164

Ans ✗ 1. $\frac{v^2}{2} - \frac{p}{\rho} - gz = constant$

✗ 2. $\frac{v^2}{2} + \frac{p}{\rho} - gz = constant$

✗ 3. $\frac{v^2}{2} - \frac{p}{\rho} + gz = constant$

✓ 4. $\frac{v^2}{2} + \frac{p}{\rho} + gz = constant$

Q.95 What is the dimension of the vector space of all 2×2 symmetric real-valued matrices?

Question ID : 1945503069

Ans ✓ 1. 3

✗ 2. 1

✗ 3. 2

✗ 4. 4

Q.96 Suppose (X, Y) jointly distributed with the following density function:

Question ID : **1945503082**

$$f(s,t) = \begin{cases} 1/x & \text{if } s^2 + t^2 \leq 1 \\ 0 & \text{otherwise} \end{cases}$$

Find $Cov(X,Y)$.

Ans ✗ 1. -1

✗ 2. 1

✔ 3. 0

✗ 4. π

Q.97 Every n-connected graph with p points has at least:

Question ID : **1945503043**

Ans ✔ 1. pn/2 lines

✗ 2. n(p + 1)/2 lines

✗ 3. pn lines

✗ 4. 2pn lines

Q.98 Which one of the following gives a pair of independent random variables?

Question ID : **1945503081**

Ans ✗ 1.

10 coins are thrown at random. X denotes the total number of heads that appear and Y denotes the total number of tails that appear.

✔ 2.

10 coins are tossed at random. X denotes the total number of heads appeared on even tosses, i.e., on 2, 4, ..., 10th toss whereas Y denotes the total number tails appeared on odd tosses, i.e., 1st, 3rd, ... 9th toss.

✗ 3.

For $1 \leq i \leq 6$, let X_i denote the number of times digit 'i' appears in 10 tosses of a dice. Consider (X_1, X_2).

✗ 4.

Two dice are thrown at random and X denote the maximum of the digits appeared and Y denote the minimum of the digits appeared.

Q.99 Find the volume of the solid bounded by the following ellipsoid.

Question ID : **1945503022**

$$\frac{x^2}{4} + \frac{y^2}{9} + \frac{z^2}{49} = 1$$

Ans ✗ 1. 124

✔ 2. 176

✗ 3. 248

✗ 4. 312

Q.10 0 For the conic $r = 1 + sin\omega$, the slope of tangent to the conic at $\omega = \pi/3$ is :

Question ID : **1945503020**

Ans

✗ 1. $\dfrac{-1}{2}$

✗ 2. $\dfrac{1}{2}$

✔ 3. -1

✗ 4. 1

Q.10 1 For $f(x,y) = x^2 y - y^3$, which one of the following gives the corresponding gradient vector field?

Question ID : **1945503092**

Ans ✗ 1. $x^2 \mathbf{i}$

✔ 2. $2xy\mathbf{i} + (x^2 - 3y^2)\mathbf{j}$

✘ 3. $x\mathbf{i} + (x^2 - y^2)\mathbf{j}$

✘ 4. $(x^3 - y^2)\mathbf{j}$

Q.102 The equation $x^2 - 6x + 6y + y^2 + 2 = 0$ represents:

Question ID : 1945503018

Ans ✘ 1.
An ellipse with latus rectum 4 and focus at (-3, 3)

✘ 2. A circle with radius 4 and centre at (-3, 3)

✔ 3. A circle with radius 4 and centre at (3, -3)

✘ 4.
An ellipse with latus rectum 4 and focus at (3, -3)

Q.103 In a toy factory, Machine A manufactures the toys and Machine B polishes and packs them. For 5 such jobs, select the optimal sequence of jobs so that the total time taken to complete all the jobs is minimum.

Question ID : 1945503052

Jobs	J1	J2	J3	J4	J5
M. A	4	13	7	11	9
M. B	9	11	8	6	12

Ans ✘ 1. J1, J2, J3, J5, J4

✔ 2. J1, J3, J5, J2, J4

✘ 3. J4, J3, J5, J2, J1

✘ 4. J1, J3, J4, J2, J5

Q.104 If $f(x,y,z) = x\sin yz$, find the gradient of f at the point $(1,3,0)$.

Question ID : 1945503088

Ans ✘ 1. $(1, 0, 3)$

✘ 2. $(1, -1, 3)$

✔ 3. $(0, 0, 3)$

✘ 4. $(0, 0, 0)$

Q.105 Which one of the following statements is true?

Question ID : 1945503076

Ans ✘ 1.
For two random variables X and Y, if $Cov(X,Y) = 0$ (covariance) then the two random variables are independent.

✘ 2. If $V(X) = 0$ (variance) then $\mathbb{P}(X = 0) = 1$

✔ 3.
Let F be the distribution function of a random variable. Then $lim_{n \to \infty} F(x + 1/n)$ always exists.

✘ 4.
If $\mathbb{P}(X \le 100) = 1$, then $\mathbb{E}(X)$ (expectation) always exists.

Q.106 In which one of the following cases, the limit exists?

Question ID : 1945503087

Ans ✘ 1. $lim_{(x,y,z) \to (0,0,0)} \dfrac{x^2 + 2y^2 + 3z^2}{x^2 + y^2 + z^2}$

✘ 2. $lim_{(x,y) \to (0,0)} \dfrac{2x^2 + \sin^2 y}{x^2 + y^2}$

✔ 3. $lim_{(x,y) \to (0,0)} \dfrac{5x^2 y}{x^2 + y^2}$

✗ 4. $\lim_{(x,y,z)\to(0,0,0)} \dfrac{2x^2 + 2y^2 - z^2}{x^2 + y^2 + z^2}$

Q.107 Consider $f(x,y) = xe^y$. At the point $(2,0)$, what is the maximum rate of change?

Question ID : 1945503086

Ans
✔ 1. $\sqrt{5}$

✗ 2. 4

✗ 3. 1

✗ 4. 0

Q.108 In a simple epidemic model $\frac{dS}{dt} = -\beta SI, \frac{dI}{dt} = \beta SI$, where $S(t)$ and $I(t)$ denote the number of susceptibles and infected persons respectively, $S(t)$ is given by:

Question ID : 1945503138

Ans
✗ 1. $S(t) = \dfrac{n(n+1)}{n + e^{(n+1)t}}$

✔ 2. $S(t) = \dfrac{n(n+1)}{n + e^{(n+1)\beta t}}$

✗ 3. $S(t) = \dfrac{n+1}{ne^{n\beta t}}$

✗ 4. $S(t) = \dfrac{n}{n + e^{n\beta t}}$

Q.109 A is an $n \times n$ non-singular matrix. Which one of the following statements is true?

Question ID : 1945503074

Ans
✗ 1.

The eigenvectors of A are orthogonal to each other.

✗ 2. All the eigenvalues are positive.

✔ 3. 0 cannot be an eigenvalue of A.

✗ 4. $tr(A) = \sum_{i=1}^{n} a_{ii} \neq 0$

Q.110 A heavy car plunges into a lake during an accident and lands at the bottom of the lake on its wheels. The door is 1.2 m high and 1 m wide, and the top edge of the door is 8 m below the free surface of the water. Then the hydrostatic force on the door is:

Question ID : 1945503149

Ans
✔ 1. 101.3 kN

✗ 2. 104.3 kN

✗ 3. 102.3 kN

✗ 4. 100.4 kN

Q.111 Value of integral $\int \sin^4 x \cos^3 x \, dx$ over $[0, \pi/2]$ is:

Question ID : 1945503034

Ans
✔ 1. 2/35

✗ 2. $\pi/6$

✗ 3. 6/35

✗ 4. $\pi/25$

Q.112 As $n \to \infty$, the sequence $s = (n^3 + 4)/(10 + 6n^3)$:

Question ID : 1945503025

Ans
✗ 1. Is undefined

✔ 2. Converges to 1/6

✗ 3. Converges to 2/5

✗ 4. Diverges

Q.113 Consider the vector space of all polynomials with real coefficients with degree bounded by 2 and define the linear functional T as $T(f) = f(0)$. Find the dimension of null space of T.

Question ID : 1945503067

Ans ✓ 1. 2

✗ 2. 4

✗ 3. 1

✗ 4. 3

Q.114 What is the probability that in a random arrangement of English alphabets, the word "MOTHER" will appear?

Question ID : 1945503075

Ans ✗ 1. $(1/6)^3$

✗ 2. $(20!)/(26!)$

✓ 3. $(21!)/(26!)$

✗ 4. $(22!)/(26!)$

Q.115 A rough uniform board of mass 'm' and length $2a$ rests on a smooth horizontal plane. A man of mass 'M' walks on it from one end to the other. The distance through which the board moves in this time is:

Question ID : 1945503156

Ans ✗ 1. $3Ma/(m+M)$

✗ 2. $3Ma/(m+2M)$

✓ 3. $2Ma/(m+M)$

✗ 4. $Ma/(m+M)$

Q.116 Which of the following is a non-abelian group?

Question ID : 1945503114

Ans ✗ 1.
The set of non-zero real numbers under multiplication.

✗ 2. The real numbers under addition.

✗ 3. The set of 2 by 2 matrices under addition.

✓ 4.
The set of 2 by 2 matrices with determinant 1 under matrix multiplication.

Q.117 Function $f(x) = |x| + sin(x)$ is:

Question ID : 1945503028

Ans ✗ 1. Convex

✗ 2. Continuous and differentiable at $x = 0$

✓ 3. Continuous but not differentiable at $x = 0$

✗ 4. Concave

Q.118 Select the correct dual of below LPP:

Question ID : 1945503048

Maximise: $z = 5x_1 + 9x_2$

Subject to constraints: $2x_1 + 5x_2 >= 37$

$6x_1 - 7x_2 >= 56$

$x_2, x_1 >= 0$

Ans

Minimise: $L = -37y_1 - 56y_2$

✔ 1. Subject to: $-2y_1 - 6y_2 >= 5$
$-5y_1 + 7y_2 >= 9$
$x_2, x_1 >= 0$

Minimise: $L = -5y_1 - 9y_2$

✘ 2. Subject to: $2y_1 + 5y_2 >= 37$
$6y_1 - 7y_2 >= 56$
$x_2, x_1 >= 0$

Minimise: $L = 5y_1 + 9y_2$

✘ 3. Subject to: $2y_1 + 5y_2 >= 56$
$6y_1 - 7y_1 >= 37$
$x_2, x_1 >= 0$

Minimise: $L = 37y_1 + 56y_2$

✘ 4. Subject to: $2y_1 + 6y_2 >= 5$
$5y_1 - 7y_2 >= 9$
$x_2, x_1 >= 0$

Q.119 The differential equation for the family of surfaces $x^3z + x^2y = c$, where c is a parameter, is:

Question ID : 1945503134

Ans

✘ 1. $(3xz + 2y)dx - xdy - x^2dz = 0$

✘ 2. $(2xz + y)dx + xdy + x^2dz = 0$

✔ 3. $(3xz + 2y)dx + xdy + x^2dz = 0$

✘ 4. $(xz + 2y)dx + xdy + xdz = 0$

Q.120 Select the function $f(z)$ from below that is analytic on the unit sphere $|z| < 1$.

Question ID : 1945503059

Ans

✘ 1. $f(z) = e^x \cdot e^{(-iy)}$

✔ 2. $f(z) = cos(x)cosh(y) - isin(x)sinh(y)$

✘ 3. $f(z) = 3x + i3xy$

✘ 4. $f(z) = 2x + ixy^2$

Q.121 The below power series expansion represents which analytic function?

Question ID : 1945503063

$\sum z^{4n+1}/(2n)! \ (n = 0,1,2,....), |z| < 100$

Ans

✘ 1. $zsinh(z)$

✘ 2. $zsinh(z^2)$

✘ 3. $1/z^2$

✔ 4. $zcosh(z^2)$

Q.122 A population of shrimp has unlimited resources and its population size grows at a rate of 10% per month. The initial population size is 1 million. The number of shrimps that may be caught each month without ultimately exhausting their population is:

Question ID : 1945503139

Ans

✘ 1. 10,000

✘ 2. 1,01,000

✔ 3. 1,00,000

✗ 4. $10,00,000$

Q.123

The particular integral of the differential equation $\frac{d^2y}{dx^2} + y = \cos x$ is:

Question ID : 1945503119

Ans

✗ 1. $\frac{1}{2}x\cos x$

✓ 2. $\frac{1}{2}x\sin x$

✗ 3. $x^2\cos x$

✗ 4. $x^2\sin x$

Q.124

Two ends A and B of a rod of length 20 cm have the temperature at 40 °C and 90 °C respectively until steady state prevails. After the steady state has prevailed, the temperature at the ends A and B are changed to 45 °C and 95 °C respectively. The temperature distribution in the root at time t is given by

$$\mu(x,t) = Ax + B + \sum_{m=1}^{\infty}\left[\frac{20}{(2m-1)\pi}\sin\frac{(2m-1)\pi x}{20} \cdot e^{-\left[\frac{k(2m-1)\pi}{20}\right]^2 t}\right], \text{ where:}$$

Question ID : 1945503132

Ans

✗ 1. $A = \frac{3}{2}, B = 42$

✗ 2. $A = 45, B = \frac{5}{2}$

✗ 3. $A = \frac{5}{2}, B = \frac{3}{2}$

✓ 4. $A = \frac{5}{2}, B = 45$

Q.125

The general solution of the differential equation $y'' - \frac{x}{x-1}y' + \frac{1}{x-1}y = 0$ is:

Question ID : 1945503118

Ans

✗ 1. $y = c_2 x - c_1 \cos x$

✗ 2. $y = c_1(x^2 - 1) + c_2 x$

✗ 3. $y = c_1 e^x - c_2 x^2 e^x$

✓ 4. $y = c_1 x - c_2 e^x$

Q.126

In a car wash with just one cleaning machine, if the cars arrive with an arrival rate of a_1 per minute and the expected service time for each car is b_1 minutes, then the utilisation factor for the car wash facility is given by:

Question ID : 1945503051

Ans

✗ 1. $1/(a_1-b_1)$

✓ 2. $a_1 * b_1$

✗ 3. a_1/b_1

✗ 4. $a_1/(a_1-b_1)$

Q.127

Which one of the following statements is false?

Question ID : 1945503108

Ans

✗ 1.

Intersection of any two subgroups is a subgroup.

✓ 2.

For any ring $(R, +, \cdot)$, the relation $a \cdot (b - c) = 0$ implies $b = c$.

✗ 3.

If $(G, \cdot)$ is abelian and H, K are subgroups of G, then $\{h.k \mid h \in H, k \in K\}$ is a subgroup of G.

✗ 4.

Z_4 (under the usual operation of modulo 4 addition) is cyclic.

Q.12

8 For what value of c is the line $y = 0.5x + c$ tangent to the parabola represented by $Y^2 = 4ax$?

Question ID : **1945503024**

Ans

✗ 1. a/2

✗ 2. a/4

✓ 3. 2a

✗ 4. a

Q.12 9 The area under the curve given by the polar co-ordinates $r = f(\omega)$ is given by:

Question ID : **1945503021**

Ans

✗ 1. $\int (r^2)\, d\omega$

✗ 2. $\int \left(\frac{r^3}{2}\right) dr$

✗ 3. $2\int (r^2)\, d\omega$

✓ 4. $\int \left(\frac{r^2}{2}\right) d\omega$

Q.13 0 If the roots of the auxiliary equation of the differential equation $\frac{d^4y}{dx^4} - 5\frac{d^3y}{dx^3} + 6\frac{d^2y}{dx^2} + 4\frac{dy}{dx} - 8y = 0$ are 2, 2, 2 and –1, then the general solution is:

Question ID : **1945503120**

Ans

✗ 1. $y = c_1 e^{2x} + c_2 e^{-x}$

✗ 2. $y = c_1 e^{2x} + c_2 e^{-x} + c_3 e^{x} + c_4 e^{-2x}$

✗ 3. $y = (c_1 + c_2 x + c_3 x^2)e^{-x} + c_4 e^{2x}$

✓ 4. $y = (c_1 + c_2 x + c_3 x^2)e^{2x} + c_4 e^{-x}$

Q.13 1 What is the order of $(2, 6)$ in $Z_6 \times Z_{12}$?

Question ID : **1945503112**

Ans

✗ 1. 1

✓ 2. 6

✗ 3. 10

✗ 4. 2

Q.13 2 Which conic does the below equation represent?

$$R = \frac{5}{(4 - 11\cos(\omega))}$$

Question ID : **1945503015**

Ans

✓ 1. Hyperbola

✗ 2. Parabola

✗ 3. Ellipse

✗ 4. Circle

Q.13 3 For any subset U of a vector space V, we have $U^{\perp} = \{v : v$ is orthogonal to x for some $x \in U\}$. Find $(U^{\perp})^{\perp}$ where $U = \{(2,0,0), (1,0,3)\}$.

Question ID : **1945503072**

Ans

✗ 1. $\mathbb{R}^3$

✗ 2. $\{(2,0,0), (1,0,3)\}$

✓ 3. $\{(x, y, z) : y = 0\}$

✗ 4. $\{(0,0,0)\}$

Q.13 $GL_n(R)$ denotes the group of $n \times n$ non-singular matrices under the operation of matrix multiplication. Which one of the following gives an Abelian (commutative) subgroup?

4

Ans ✗ 1.
Set of all non-singular upper triangular matrices.

✗ 2.
Set of all non-singular matrices with positive trace.

✗ 3.
Set of all matrices with positive determinant.

✔ 4. Set of all non-singular diagonal matrices.

Question ID : 1945503106

Q.13 5 The below Taylor series expansion represents which analytic function?

$\sum (-1)^n z^{2n+1} / (2n+1)! \ (n = 0, 1, 2, \ldots.)$

Ans ✗ 1. Tanz

✔ 2. Sinz

✗ 3. Coshz

✗ 4. Cosz

Question ID : 1945503062

Q.13 6 Let $f(x) = \left(\frac{1}{x^2}\right) - 5$ be a function defined on interval [1, 4]. Which of the points holds true?

Ans ✗ 1.
There exists a point x in [1, 4] such that f is not differentiable at x

✗ 2.
The function has a tangent line between [1, 4] with slope -1/64

✗ 3.
The function has a tangent line between [1, 4] with slope 3/2

✔ 4.
The function has a tangent line between [1, 4] with slope -5/16

Question ID : 1945503032

Q.13 7 The moment of inertia of an ellipse of mass 'M' and semiaxes a and b about a tangent is: (where p is the perpendicular from the centre on the tangent.)

Ans ✔ 1. $\frac{5M}{4} p^2$

✗ 2. $\frac{5M}{6} p^2$

✗ 3. $\frac{5M}{2} p^2$

✗ 4. $\frac{5M}{3} p^2$

Question ID : 1945503153

Q.13 8 Two equal uniform rods AB and AC, each of length $2b$, are freely joined at A and are rested on a smooth vertical circle of radius a. If 2θ is the angle between them, then:

Ans ✗ 1. $a \sin^3\theta = b \cos\theta$

✗ 2. $b \sin^2\theta = a \cos\theta$

✗ 3. $a \sin^2\theta = b \cos\theta$

✔ 4. $b \sin^3\theta = a \cos\theta$

Question ID : 1945503146

Q.13 9 A particle starts from origin. The components of its velocity parallel to the axes of coordinator at time 't' are 2t + 3 and 4t. Then the path travelled by the particle is given by:

Ans ✗ 1. $4x^2 - y^2 - 4xy + 18y = 0$

✗ 2. $x^2 + y^2 + xy - 12y = 0$

Question ID : 1945503155

✗ 3. $3x^2 + y^2 + 4xy - 18y = 0$

✓ 4. $4x^2 + y^2 - 4xy - 18y = 0$

Q.140 The minimised form of the logical expression $(A^cB^cC^c + A^cBC^c + A^cBC + ABC^c)$ is:

Question ID : 1945503098

Ans ✓ 1. $A^cC^c + BC^c + A^cB$

✗ 2. $(AC)^c + (BC)^c + (AB)^c$

✗ 3. $A^cC + B^cC + A^cB^c$

✗ 4. $AC^c + B^cC + AB^c$

Q.141 Evaluate $lim_{(x,y,z)\to(3,0,1)} exp^{-xy}\sin(xy/z)$:

Question ID : 1945503093

Ans ✗ 1. π

✗ 2. 1

✓ 3. 0

✗ 4. Does not exist

Q.142 The inputs of a NAND gate are connected together. The resulting circuit is:

Question ID : 1945503103

Ans ✗ 1. OR

✗ 2. XOR

✓ 3. NOT

✗ 4. AND

Q.143 Which of the following is a Cauchy-Euler equation?

Question ID : 1945503122

Ans ✓ 1. $x^3\dfrac{d^3y}{dx^3} - 4x^2\dfrac{d^2y}{dx^2} + 8x\dfrac{dy}{dx} - 8y = 4lnx$

✗ 2. $x^3\dfrac{d^3y}{dx^3} - 2x\dfrac{d^2y}{dx^2} + 18y = 2x^3$

✗ 3. $x^2\dfrac{d^4y}{dx^4} - x^3\dfrac{d^3y}{dx^3} + x\dfrac{d^2y}{dx^2} = e^x$

✗ 4. $\dfrac{d^2y}{dx^2} + 2xy = x^3$

Q.144 If $y = y_1(x)$ is not a known solution, then by the removal of the first derivative, the general solution of $y'' + P(x)y' + Q(x)y = R(x)$ is obtained, where y_1 is given by:

Question ID : 1945503121

Ans ✗ 1. $e^{\int Pdx}$

✗ 2. $e^{\frac{1}{2}\int Pdx}$

✓ 3. $e^{-\frac{1}{2}\int Pdx}$

✗ 4. $e^{-\int Pdx}$

Q.145 Let X and Y be two independent $N(0,1)$ random variables. Find $Cov(X + 3Y, 5X - 2y)$.

Question ID : 1945503079

Ans ✗ 1. 1

✓ 2. −1

✗ 3. 0

✗ 4. 11

Q.146 Maximum point connectivity of a graph G with p vertices and q edges, where q > = p − 1, is:

Question ID : 1945503044

Ans

✗ 1. $q - 1$

✗ 2. $q + 1$

✓ 3. $2q/p$

✗ 4. q/p

Q.147 Which one of the following statements is false?

Question ID : 1945503077

Ans

✗ 1. Two independent events cannot be disjoint.

✓ 2.
For a probability density function f, we always have $|f(x)| \leq 1$ for all $x \in \mathbb{R}$.

✗ 3.
For $N(0,2)$ random variable, we have mean = median = mode.

✗ 4.
Any continuous non-negative function with $\int_{-\infty}^{\infty} f(x)dx = 1$ gives a density function.

Q.148 A solid frustum of a paraboloid of revolution of height 'h' and latus rectum $4a$ rests with its vertex on the vertex of a paraboloid of revolution whose latus rectum is $4b$. Then the equilibrium is stable if:

Question ID : 1945503147

Ans

✓ 1. $h < \dfrac{3ab}{a+b}$

✗ 2. $h < \dfrac{2ab}{a+b}$

✗ 3. $h > \dfrac{ab}{a+b}$

✗ 4. $h > \dfrac{3ab}{a+b}$

Q.149 What is the order of an element g of a cyclic group G?

Question ID : 1945503113

Ans

✓ 1.
The smallest integer r such that g^r is the identity.

✗ 2. The order axioms imposed on the group.

✗ 3. The number of elements in the group.

✗ 4.
The number of element $a \in G$ such that $a^2 = e$, the identity.

Q.150 The binary number 10101 is equivalent to the decimal number:

Question ID : 1945503095

Ans

✗ 1. 12

✗ 2. 27

✗ 3. 19

✓ 4. 21