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Class: XII
Subject: Maths
Topic: Differential Equation
No. of Questions: 24

Q1. Consider the differential equation $\frac{dy}{dx} = \frac{y}{2y \log\ y+y-x}$

A. Statement – 1 is true, statement – 2 is true and statement – 2 is the correct explanation for statement – 1.
B. Statement – 1 is true, statement – 2 is true and statement – 2 is not the correct explanation for statement – 1.
C. Statement – 1 is true, statement – 2 is false.
D. Statement – 1 is false, statement – 2 is true.

Q2. Statement – 1: The differential equation of all circles in a plane must be of order 3.
Statement – 2 : There is only one circle passing through three non-collinear points.

A. Statement – 1 is true, statement – 2 is true and statement – 2 is the correct explanation for statement – 1.
B. Statement – 1 is true, statement – 2 is true and statement – 2 is not the correct explanation for statement – 1.
C. Statement – 1 is true, statement – 2 is false.
D. Statement – 1 is false, statement – 2 is true.

Q3. Statement -1: Curve satisfying the differential equation y' = y/2x through (2,1) is a parabola with focus (1/4, 0)

Statement – 2: The differential equation y' = y/2x is of variable separable form.

A. Statement – 1 is true, statement – 2 is true and statement – 2 is the correct explanation for statement – 1.
B. Statement – 1 is true, statement – 2 is true and statement – 2 is not the correct explanation for statement – 1.
C. Statement – 1 is true, statement – 2 is false.
D. Statement – 1 is false, statement – 2 is true.

Q4 Let a solution y = y(x) of the differential equation $x\sqrt{x^2-1}\,dy - y\sqrt{y^2-1}\,dx = 0$ satisfy $y(2) = 2\sqrt{3}$

Statement – 1: $y(x) = \sec(\sec^{-1} x - \pi/6)$

Statement – 2: y(x) is given by $\frac{1}{y} = \frac{2\sqrt{3}}{x} - \sqrt{1-\frac{1}{x^2}}$

A. Statement – 1 is true, statement – 2 is true and statement – 2 is the correct explanation for statement – 1.
B. Statement – 1 is true, statement – 2 is true and statement – 2 is not the correct explanation for statement – 1.
C. Statement – 1 is true, statement – 2 is false.
D. Statement – 1 is false, statement – 2 is true.

Q5. Let $(xy^2 + x)dx + (y - x^2y)dy = 0$ satisfy $y(0) = 0$.

Statement – 1: The curve represented by the solution of the given differential equation is a circle.

Statement – 2: It is circle with radius 1 and centre (0, 0).

A. Statement – 1 is true, statement – 2 is true and statement – 2 is the correct explanation for statement – 1.
B. Statement – 1 is true, statement – 2 is true and statement – 2 is not the correct explanation for statement – 1.
C. Statement – 1 is true, statement – 2 is false.
D. Statement – 1 is false, statement – 2 is true.

Q6. Let $y' + \sin\frac{x+y}{2} = \sin\frac{x-y}{2}$

Statement – 1: A solution satisfying $y(0) = \pi$ is a periodic function with period 4π.

Statement – 2: y can be explicitly represented in terms of x.

A. Statement – 1 is true, statement – 2 is true and statement – 2 is the correct explanation for statement – 1.
B. Statement – 1 is true, statement – 2 is true and statement – 2 is not the correct explanation for statement – 1.
C. Statement – 1 is true, statement – 2 is false.
D. Statement – 1 is false, statement – 2 is true.

Q7. Let f(x) be differentiable on the interval (0, ∞) such that f(1) = 1, and $\lim_{t \to x} \frac{t^2 f(x) - x^2 f(t)}{t - x} = 1$ for each x > 0. Then f(x) is

A. $\frac{1}{3x} + \frac{2x^2}{3}$

B. $-\frac{1}{3x} + \frac{4x^2}{3}$

C. $-\frac{1}{x} + \frac{2}{x^2}$

D. $\frac{1}{x}$

Q8. Let I be the purchase value of an equipment and V(t) be the value after it has been used for t years. The value V(t) depreciates at a rate given by differential equation $\frac{dV(t)}{dt} = -k(T - t)$, where k > 0 is a constant and T is the total life in years of the equipment. Then the scrap value V(T) of the equipment is:

A. e^{-kT}

B. $T^2 - \frac{1}{k}$

C. $I - \frac{KT^2}{2}$

D. $I - K(T)$

Q9. The solution of $x^3 \frac{dy}{dx} + 4x^2 \tan y = e^x \sec y$ satisfying y(1) = 0 is

A. $\tan y = (x - 2)\, e^x \log x$

B. $\sin y = e^x (x - 1)\, x^{-4}$

C. $\tan y = (x - 1)\, e^x\, x^{-3}$

D. $\sin y = e^x (x - 1)\, x^{-3}$

Q10. A solution of the equation $x\frac{dy}{dx} = y(\log y - \log x + 1)$ is

A. $y = xe^{cx}$
B. $y^2/x = cx$
C. $y^2 = cx \log x$
D. $\log y = cx$

Q11. The population p(t) at time t of a certain mouse species follows the differential equation $\frac{dp(t)}{dt} = 0.5\,p(t) - 450$. If p(0) = 850, then the time at which the population becomes zero is

A. log 9
B. $\frac{1}{2}\log 18$
C. log 18
D. 2 log 18

Q12. The degree and order respectively of the differential equation of all parabolas whose axis is x-axis, are:

A. 2, 1
B. 1, 2
C. 2, 2
D. 1, 1

Q13. The equation of the curve whose tangent at any point (x, y) makes an angle $\tan^{-1}(2x + 3y)$ with x-axis and which passes through (1, 2) is:

A. $6x + 9y + 2 = 26e^{3(x-1)}$
B. $6x - 9y + 2 = 26e^{3(x-1)}$
C. $6x + 9y - 2 = 26e^{3(x-1)}$
D. $6x - 9y - 2 = 26e^{3(x-1)}$

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Q14. If for the differential equation $y' = \frac{y}{x} + \phi\left(\frac{x}{y}\right)$ the general solution is $y = \frac{x}{\log|Cx|}$ then ϕ (x/y) is given by

A. $-x^2/y^2$
B. y^2/x^2
C. x^2/y^2
D. $-y^2/x^2$

Q15. The solution y(x) of the differential equation $\frac{d^2y}{dx^2} = \sin 3x + e^x + x^2$ when $y_1(0) = 1$ and $y(0) = 0$ is

A. $-\frac{\sin 3x}{9} + e^x + \frac{x^4}{12} + \frac{1}{3}x - 1$
B. $-\frac{\sin 3x}{9} + e^x + \frac{x^4}{12} + \frac{1}{3}x$
C. $-\frac{\cos 3x}{3} + e^x + \frac{x^4}{12} + \frac{1}{3}x + 1$
D. none of these

Q16. The differential equation $\frac{dy}{dx} = \frac{\sqrt{1-y^2}}{y}$ determines a family of circles with

A. variable radii and a fixed centre (0, 1)
B. variable radii and a fixed centre (0, – 1)
C. fixed radius 1 and a variable centres along the x-axis
D. fixed radius 1 and variable centres along the y-axis

Q17. The orthogonal trajectories of the family of curves $a^{n-1} y = x^n$ are given by

A. $x^n + n^2 y = \text{const}$
B. $ny^2 + x^2 = \text{const}$
C. $n^2 x + y^n = \text{const}$
D. $n^2 x - y^n = \text{const}$

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Q18. The solution of the differential equation $\frac{d^2x}{dr^2} + x = 0$; x(0) = 1, x'(0) = 0

A. approaches infinity as $t \to \infty$
B. is a periodic function
C. is always greater than or equal to unity
D. does not exist

Q19. The solution of differential equation $\frac{dy}{dx} = \frac{y}{x} + 2\frac{\phi(y/x)}{\phi'(y/x)}$ is

A. $x^2\phi(y/x) = k$
B. $y^2\phi(y/x) = k$
C. $\phi(y/x) = k\,x^2$
D. $\phi(y/x) = k\,y^2$

Q20. The degree of the differential equation satisfying $\sqrt{1+x^2} + \sqrt{1+y^2} = A\left(X\sqrt{1+y^2} - y\sqrt{1+x^2}\right)$ is

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

Q21. Write the degree of the differential equation
$\left(\frac{dy}{dx}\right)^4 + 3x\frac{d^2y}{dx^2} = 0.$ [Delhi 2013]

Q22. Write the differential equation representing the family of curves y=mx, where m is and arbitrary constant [All India 2013]

Q23. Find the differential equation of family of circles touching y-axis at the origin.

[Hots; Delhi 2010C; All India 2009C]

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Q24. Form the differential equation representing family of ellipses having foci on X-axis and centre at the origin. [Hots;Delhi 2009C]