PhysicsByAaryan

CSIR NET . GATE . JEST . BARC - Physics

Ordinary Differential Equations - CSIR NET Physics PYQs

Mathematical Physics . All PYQs (2015-2025) with answer key

13 questions . Answer key included

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Q1. [Dec 2015] . 3.5 marks

Mathematical Physics > Ordinary Differential Equations

CSIR NET	2015 Dec	3.5 M

The solution of the differential equation $\frac{dx}{dt} = 2\sqrt{1-x^2}$, with initial condition $x = 0$ at $t = 0$ is

1. $x = \begin{cases} \sin 2t, & 0 \leq t < \frac{\pi}{4} \\ \sinh 2t, & t \geq \frac{\pi}{4} \end{cases}$

2. $x = \begin{cases} \sin 2t, & 0 \leq t < \frac{\pi}{2} \\ 1, & t \geq \frac{\pi}{2} \end{cases}$

3. $x = \begin{cases} \sin 2t, & 0 \leq t < \frac{\pi}{4} \\ 1, & t \geq \frac{\pi}{4} \end{cases}$

4. $x = 1 - \cos 2t, t \geq 0$

Q2. [June 2015] . 3.5 marks

Mathematical Physics > Ordinary Differential Equations

CSIR NET	2015 June	3.5 M

Consider the differential equation $\frac{d^2x}{dt^2} - 3\frac{dx}{dt} + 2x = 0$. If $x = 0$ at $t = 0$ and $x = 1$ at $t = 1$, the value of x at $t = 2$ is

1. $e^2 + 1$
2. $e^2 + e$
3. $e + 2$
4. $2e$

Q3. [Dec 2017] . 3.5 marks

Mathematical Physics > Ordinary Differential Equations

CSIR NET	2017 Dec	3.5M

The number of linearly independent power series solutions, around $x = 0$, of the second order linear differential equation $x\frac{d^2y}{dx^2} + \frac{dy}{dx} + xy = 0$, is

1. 0 (this equation does not have a power series solution)
2. 1
3. 2
4. 3

Q4. [June 2017] . 3.5 marks

Mathematical Physics > Ordinary Differential Equations

CSIR NET	2017 June	3.5M

The function $y(x)$ satisfies the differential equation $x\frac{dy}{dx} + 2y = \frac{\cos\pi x}{x}$. If $y(1) = 1$, the value of $y(2)$ is

1. π
2. 1
3. $1/2$
4. $1/4$

Q5. [Dec 2018] . 3.5 marks

Mathematical Physics > Ordinary Differential Equations

CSIR NET	2018 Dec	3.5M

In terms of arbitrary constants A and B, the general solution to the differential equation

$$x^2\frac{d^2y}{dx^2} + 5x\frac{dy}{dx} + 3y = 0 \text{ is}$$

1. $y = \frac{A}{x} + Bx^3$
2. $y = Ax + \frac{B}{x^3}$
3. $y = Ax + Bx^3$
4. $y = \frac{A}{x} + \frac{B}{x^3}$

Q6. [June 2018] . 3.5 marks

Mathematical Physics > Ordinary Differential Equations

CSIR NET	2018 June	3.5M

Consider the following ordinary differential equation

$$\frac{d^2x}{dt^2} + \frac{1}{x}\left(\frac{dx}{dt}\right)^2 - \frac{dx}{dt} = 0$$

with the boundary conditions $x(t=0)=0$ and $x(t=1)=1$. The value of $x(t)$ at $t=2$ is

1. $\sqrt{e-1}$
2. $\sqrt{e^2+1}$
3. $\sqrt{e+1}$
4. $\sqrt{e^2-1}$

Q7. [June 2019] . 3.5 marks

Mathematical Physics > Ordinary Differential Equations

CSIR NET	2019 June	3.5M

The solution of the differential equation

$x\frac{dy}{dx} + (1+x)y = e^{-x}$ with the boundary condition $y(x=1) = 0$, is

1. $\frac{(x-1)}{x}e^{-x}$
2. $\frac{(x-1)}{x^2}e^{-x}$
3. $\frac{(1-x)}{x^2}e^{-x}$
4. $(x-1)^2e^{-x}$

Q8. [June 2020] . 5.0 marks

Mathematical Physics > Ordinary Differential Equations

CSIR NET	2020 June	5M

The solution of the differential equation $\left(\frac{dy}{dx}\right)^2 - \frac{d^2y}{dx^2} = e^y$, with the boundary conditions $y(0) = 0$ and $y'(0) = -1$, is

1. $-\ln\left(\frac{x^2}{2} + x + 1\right)$
2. $-x\ln(e+x)$
3. $-xe^{-x^2}$
4. $-x(x+1)e^{-x}$

Q9. [June 2021] . 3.5 marks

Mathematical Physics > Ordinary Differential Equations

CSIR NET	2021 June	3.5M

The equation of motion of a one-dimensional forced harmonic oscillator in the presence of a dissipative force is described by $\frac{d^2x}{dt^2} + 10\frac{dx}{dt} + 16x = 6te^{-8t} + 4t^2e^{-2t}$. The general form of the particular solution, in terms of constants A, B etc., is

1. $t(At^2 + Bt + C)e^{-2t} + (Dt + E)e^{-8t}$
2. $(At^2 + Bt + C)e^{-2t} + (Dt + E)e^{-8t}$
3. $t(At^2 + Bt + C)e^{-2t} + t(Dt + E)e^{-8t}$
4. $(At^2 + Bt + C)e^{-2t} + t(Dt + E)e^{-8t}$

Q10. [Dec 2023] . 5.0 marks

Mathematical Physics > Ordinary Differential Equations

CSIR NET	2023 Dec	5 M

The solution $y(x)$ of the differential equation $y'' + \frac{y}{4} = \frac{x}{2}$, where $0 \leq x \leq \pi$, together with the boundary conditions $y(0) = y(\pi) = 0$ is

1. $\frac{2}{\pi}\sum_{n=1}^{\infty}(-1)^n \frac{\pi}{n}\frac{\sin nx}{\frac{1}{4}-n^2}$
2. $\frac{2}{\pi}\sum_{n=1}^{\infty}(-1)^n \frac{\pi}{2n}\frac{\sin nx}{\frac{1}{4}-n^2}$
3. $\frac{2}{\pi}\sum_{n=1}^{\infty}(-1)^{n+1} \frac{\pi}{n}\frac{\sin nx}{\frac{1}{4}-n^2}$
4. $\frac{2}{\pi}\sum_{n=1}^{\infty}(-1)^{n+1} \frac{\pi}{2n}\frac{\sin nx}{\frac{1}{4}-n^2}$

Q11. [June 2024] . 5.0 marks

Mathematical Physics > Ordinary Differential Equations

CSIR NET	2024 June	5M

The general solution for the second order differential equation

$$\frac{d^2y}{dx^2} - y = x\sin x$$

will be

1. $C_1e^x + C_2e^{-x} - \frac{1}{2}(x\sin x + cos\, x)$
2. $C_1e^x + C_2e^{-x} - \frac{1}{2}(sin\, x - x\cos x)$
3. $C_1e^x + C_2e^{-x} + \frac{1}{2}x(sin\, x - cos\, x)$
4. $C_1e^x + C_2e^{-x} + \frac{1}{2}x(\sin x + \cos x)$

(where C_1 and C_2 are arbitrary constants)

Q12. [June 2025] . 3.5 marks

Mathematical Physics > Ordinary Differential Equations

CSIR NET	2025 June	3.5M	MMP

The solutions of the differential equation

$$\frac{dy}{dx} = -\frac{x}{y+1}$$

are a family of

1. ellipses with different eccentricities
2. circles with different centres
3. circles with different radii
4. ellipses with different foci

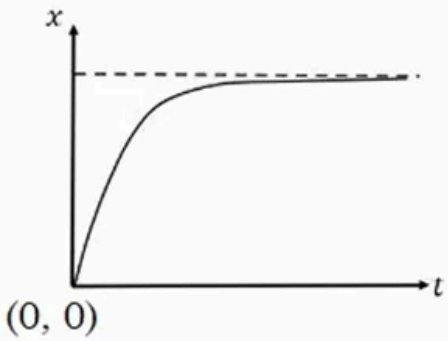
Q13. [June 2025] . 5.0 marks

Mathematical Physics > Ordinary Differential Equations

CSIR NET	2025 June	5M	MMP

Which one of the following curves best represents the solution of the differential equation $\frac{dx}{dt} + x = 1$, with the initial condition $x(0) = 0$?

1.



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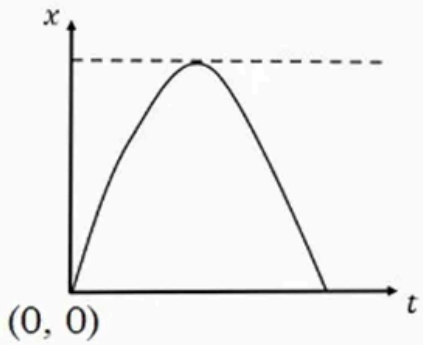
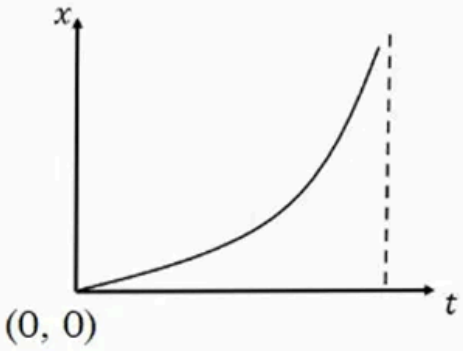
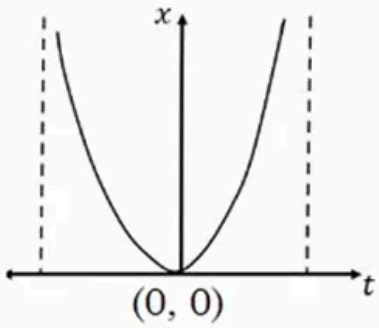


2.



4.



Answer Key

13 questions . Subject and topic for quick revision

Q. No	Subject	Topic	Answer
Q1	Mathematical Physics	Ordinary Differential Equations	**3**
Q2	Mathematical Physics	Ordinary Differential Equations	**2**
Q3	Mathematical Physics	Ordinary Differential Equations	**2**
Q4	Mathematical Physics	Ordinary Differential Equations	**4**
Q5	Mathematical Physics	Ordinary Differential Equations	**4**
Q6	Mathematical Physics	Ordinary Differential Equations	**3**
Q7	Mathematical Physics	Ordinary Differential Equations	**1**
Q8	Mathematical Physics	Ordinary Differential Equations	**1**
Q9	Mathematical Physics	Ordinary Differential Equations	**3**
Q10	Mathematical Physics	Ordinary Differential Equations	**4**
Q11	Mathematical Physics	Ordinary Differential Equations	**1**
Q12	Mathematical Physics	Ordinary Differential Equations	**3**
Q13	Mathematical Physics	Ordinary Differential Equations	**1**

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