MATHS

BOOKS - CHHAYA PUBLICATION MATHS (BENGALI ENGLISH)

ORDER AND DEGREE OF DIFFERENTIAL EQUATION

Example

1. Find the differential equation of the family of circles

$x^2 + y^2 = 2ax$, where a is a parameter .

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2. Find the differential equation of the family of circles

$x^2 + y^2 = 2ay$, where a is a parameter .

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3. Find the differential equation of $y = Ax + \frac{B}{x}$, where A and B are arbitrary constants .

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4. From the differential equation representing the family of curves y = A cos (x + b) , where A and B are parameters .

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5. Eliminate A and B from $y = A\cos 2x + B\sin 2x + \frac{1}{2}e^{2x}$.

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6. From the relation $ax + by + c = 0[b \neq 0]$, from a differential equation elimenting a, b, c .

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7. From the differential equation corresponding to $y^2a(b-x)(b+x)$ by eliminating the parameters a and b .

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8. Find the differential equation of all circles touching the x-axis at the origin .

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9. Prove that , $(x-\alpha)^2+(y-\beta)^2=a^2.$ for all α and β satisfiles the differential equation $\left(1+y_1^2\right)^3=(ay_2)^2.$

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10. From the differential equation corresponding to

$y^2 - 2ay + x^2 = a^2$ by eliminating a.

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11. From the differential equation of the family of ellipses

$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ by eliminating arbitrary constants a and b.

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Exercise Mcq

1. Let x be the number of indepandent constants in

the general solution of a differential of order y then -

A. x=y

B. $x > y$

C. $x < y$

D. $x \geq y$

Answer: A

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2. The degree of the differential equation $\left(\frac{dy}{dx}\right)^2 - 2\frac{dy}{dx} = 3x$ is -

A. 1

B. 2

C. 3

D. 4

Answer: B

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3. The order of the differential equation $\left(\frac{d^2y}{dx^2}\right)^3 - \left(\frac{dy}{dx}\right)^4 + 5y = x$ is -

A. 1

B. 3

C. 2

D. 4

Answer: C

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4. $\frac{d^3y}{dx^3} + y = \sqrt[3]{1 + \frac{dy}{dx}}$ is a differential equation of degree-

A. 1

B. 2

C. 4

D. 3

Answer: D

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5. The order of the differential equation obtained by the elimination of arbitrary constants a,b,c from the equation ax + by + c = 0 is -

A. 2

B. 3

C. 1

D. none of these

Answer: A

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6. The degree of the differential equation

$$\left(\frac{d^2y}{dx^2}\right)^2 + \frac{d^2y}{dx^2} - \left(\frac{dy}{dx}\right)^4 + \frac{dy}{dx} + y = 6x^3$$ is -

A. 4

B. 3

C. 2

D. 1

Answer: C

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7. The order of differential equation $\left(\frac{d^4y}{dx^4}\right)^3 - \frac{d^3y}{dx^3} = \sqrt{1 + \frac{dy}{dx}}$ is -

A. 6

B. 4

C. 3

D. 7

Answer: B

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Exercise Very Short Answer Type Questions

1. $y^2 = 4ax$

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2. $y = mx + 5$

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

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4. $y = a\cos 2x$

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5. $y = c\log x - 2$

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6. Eliminate m , $y = e^{mx}$

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7. Show that , $v = \frac{A}{r} + B$ satisfies the differential equation $\frac{d^2v}{dr^2} + \frac{2}{r}.\frac{dv}{dr} = 0$

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8. Show that the differential equation $\frac{dy}{dx} = y$ is formed by eliminating a and b from the relation $y = ae^{b+x}$.

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9. Prove that , $x = A\cos\sqrt{\mu t}$ is a solution of the differential equation $\frac{d^2x}{dt^2} + \mu x = 0$

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Exercise Short Answer Type Questions

1. Eliminate A and B, $y = Ae^x + Be^{-x}$

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2. $y = ax + bx^2$

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3. Eliminate A and B, $y = Ae^{x} + Be^{-x} + x^{2}$

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4. $ax^{2} + by^{2} = 1$

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5. $y = a\tan^{-1}x + b$

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6. $y = (ax + b)e^{-2x}$

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7. Eliminate A and B, $y = A \sin mx + B \cos mx$

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8. $y = ax + bx^3$

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9. $x = e^{-t}(a \cos t + b \sin t)$

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10. $(y - b)^2 = 4k(x - a)$

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11. Eliminate a and b, $y = a \sec x + b \tan x$

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12. $xy = Ae^{x} + Be^{-x}$

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13. Show that the differential equation $x\left(yy_2 + y_1^2\right) = yy_1$ is formed by eliminating a, b and c from the relation

$ax^2 + by^2 + c = 0$. Justify why the eliminate is of the second order although the given relation involves three constants a, b and c .

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14. Show that , the solution $x = A\cos(nt + B) + \frac{k}{n^2 - p^2}.\sin pt$, for all A and B satisfies the differential equation

$\frac{d^2x}{dt^2} + n^2x = k\sin pt$.

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15. Show that , the solution $x = e^{-kt}$ (a cos nt + b sin nt), for all a and b , always satisfies the differenital equation

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

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16. Show that the solution $y = a\sin x + b\cos x + x\sin x$ satisfies ,

$$\frac{d^2y}{dx^2} + y = 2\cos x$$

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17. Show that , the equation of all circles touching the y-axis at the origin is ,

$$2xy\frac{dy}{dx} = y^2 - x^2$$

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18. Find a differential equation which is satisfied by all curves $y = Ae^{2x} + Be^{-\frac{x}{2}}$, where A and B are non-zero constants .

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19. Form the differential equation of the family of hyperbolas $b^2x^2 - a^2y^2 = a^2b^2$ by eliminating constants a and b .

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20. Determine the differential equation of the family of parabolas whose axis are coincident with the axis of x.

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21. From the differential equation of family of parabolas having vertex at the origin and axis along positive y-axis .

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22. From the differential equation of the family of circles

$(x-a)^2+(y-a)^2-a^2$, where a is an arbitrary constant .

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23. Show that the function y= A cos 2x - B sin 2x is a solution of

the differential equation $\frac{d^2y}{dx^2}+4y=0$

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24. Form the differential equation of the family of circles having centre on

the x-axis and passing through the origin .

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25. From the differential representing the family of ellipses having centre at the origin and foci on y-axis .

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26. From the differential equation of the family of circles in the second quadrant and touching the coordinate axes.

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27. From the differential equation that represents all parabolas each of which has a latus rectum 4a, and whose axes are parallel to the x-axis .

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28. If a is a prameter , show that the differential equation of the family of curves $y = \frac{a - x}{ax + 1}$ is $(x^2 + 1)\frac{dy}{dx} + y^2 + 1 = 0$.

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Sample Questions For Competitive Examination A Multiple Correct Answers Type

1. The differential equation whose solution is

$(x-\alpha)^2+(y-\beta)^2=a^2$ [for all α and β where a is constant] of is -

A. order 2

B. order 3

C. degree 2

D. degree 3

Answer:

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2. The differential equation whose solution is $V = \frac{A}{r} + B$ (where A , B are constants) is of -

A. order 1

B. degre 2

C. order 2

D. degree 1

Answer:

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3. The differential equation whose solution is $ax^2 + by^2 + c = 0$ (where a,b,c are constants) is of -

A. order 2

B. degree 1

C. order 1

D. degree 2

Answer:

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4. The differential equation whose solution is

$(y-b)^2 = 4k(x-a)$ (where b,a,k are constants) is of

A. degree 1

B. order 2

C. degree 3

D. order 3

Answer:

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5. The differential equation whose solution is $x = A\cos\sqrt{\mu t}$ (where A is constant) is of -

A. order 1

B. degree 1

C. order 2

D. degree 2

Answer:

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Sample Questions For Competitive Examination B Integer Answer Type

1. if $\frac{d^3y}{dx^3} + y = \sqrt[3]{1 + \frac{dy}{dx}}$ be a differential equation whose degree is n , then the value of n is -

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2. $\left\{1+\left(\frac{dy}{dx}\right)^2\right\}^{\frac{3}{2}} = a\frac{d^2y}{dx^2}$ be a differential equation whose degree is n, then the value of n is -

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3. If order of $3ky_2 + y_1^3 = 0$ be n , then the value of n is -

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4. If $e^{\frac{d^3y}{dx^3}} - 4x\frac{dy}{dx} = 0$ be a differential equation whose order is k, find the value of k.

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5. If order of $1+\left(\frac{dy}{dx}\right)^5 = \frac{d^3y}{dx^3}$ be n, then n will be -

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Sample Questions For Competitive Examination C Matrix Match Type

1. Find the order and degree of the equation

$$x\frac{dy}{dx}+y^2+3y\left(\frac{d^2y}{dx^2}\right)^2=0$$

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2. Find the order and degree of the equation $y^2+x^2\frac{dy}{dx}-2xy\frac{d^3y}{dx^3}=0$

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Sample Questions For Competitive Examination D Comprehension Type

1. Consider the family of curves represented by the equation

$(x-h)^2+(y-k)^2=r^2$ where h and k are arbitrary constants .

The differential equation of the above family is of order-

A. 1

B. 2

C. 3

D. 4

Answer:

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2. Consider the family of curves represented by the equation

$(x-h)^2+(y-k)^2=r^2$ where h and k are arbitrary constants .

The differential equation of the above family is of curves -

A. $\left(1+y_1^2\right)^3=ry_2$

B. $y_1\left(1+y_1^2\right)^3=r^2y_2^2$

C. $\left(1+y_1^2\right)^3=r^2y_2^{2\square}$

D. none of these

Answer:

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3. Consider the family of curves represented by the equation

$(x-h)^2+(y-k)^2=r^2$ where h and k are arbitrary constants .

Degree of $\frac{dy}{dx}$ is -

A. 3

B. 4

C. 5

D. 6

Answer:

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4. The differential equation of all parabolas whose axis are parallel to the y-axis is (a) $(b)(c)(d)\frac{(e)(f)d^{(g)3(h)}(i)y}{j}\left((k)d(l)x^{(m)3(n)}(o)\right)(p)(q)=0(r)$ (s) (b) $(t)(u)(v)\frac{(w)(x)d^{(y)2(z)}(aa)x}{bb}\left((cc)d(dd)y^{(ee)2(ff)}(gg)\right)(hh)(ii)=C(jj$ (kk) (c) *[Math Processing Error]* (ii) (d) *[Math Processing Error]* (ggg)

A. $\frac{d^3y}{dx^3}=0$

B. $\frac{d^2y}{dx^2}=c$

C. $\frac{d^3y}{dx^2}+\frac{d^2y}{dx^2}=0$

D. $\frac{d^2y}{dx^2}+2\frac{dy}{dx}=c$

Answer:

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5. Find the order and degree of the equation $5x^2=y+xy\left(\frac{dy}{dx}\right)^3$

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6. Differential equation of the family of circles touching the line $y = 2$ at

$(0, 2)$ is (a)

$(b)(c)(d)x^{(e)2(f)}(g) + (h)(i)((j)(k)y - 2(l))^{(m)2(n)}(o) + (p)\frac{(q)dy}{r}((s)$

(z) (aa) *[Math Processing Error]* (uu) (vv)

$(ww)(\ \times\ )(yy)x^{(zz)2(aaa)}(bbb) + (ccc)(ddd)((eee)(fff)y - 2(ggg))^{(hhh)2}$

$-2(vvv)\Big) = 0(www)$

(xxx) (yyy) None of these

A. $x^2 + (y-2)^2 + \frac{dy}{dx}(y-2) = 0$

B. $x^2 + (y-2)\left(2 - 2x\frac{dx}{dy} - y\right) = 0$

C. $x^2 + (y-2)^2 + \left(\frac{dx}{dy} + y - 2\right)(y-2) = 0$

D. none of these

Answer:

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Sample Questions For Competitive Examination E Assertion Reasion Type

1. Statement - I : The differential equation of curves represented by $y = Ae^x$ is given by $\frac{dy}{dx} = y$

Statement-II: $\frac{dy}{dx} = y$ is valid for every member of the given family

A. Statement-I is True , Statement-II is True , Statement-II is a correct explanation for statement-I

B. Statement-I is True , Statements-II is True , Statement-II is not a correct explanation for statement-I

C. Statement-I True , Statement-II is False.

D. Statement-I is False , Statement-II is True .

Answer:

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2. Find the order and degree of the equation

$$x^2 \frac{dy}{dx} = y^2 + 3xy\left(\frac{d^2y}{dx^2}\right)^3$$

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