# MATHS

## BOOKS - RS AGGARWAL MATHS (HINGLISH)

## DIFFERENTIAL EQUATIONS WITH VARIABLE SEPARABLE

**Solved Examples**

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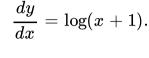**1.** Find the general solution of the differential equation

$$(x + 2)\frac{dy}{dx} = x^2 + 5x - 3(x \neq -2).$$

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**2.** Find the general solution of the differential equation

$$(1 + x^2)\frac{dy}{dx} - x = 2\tan^{-1}x.$$

**3.** Find the general solution of the differential equation

$$\frac{dy}{dx} = \log(x + 1).$$

**4.** Find the general solution of the differential equation

$$\frac{dy}{dx} = \sin^{-1} x.$$

**5.** Find the general solution of the differential equations

`(dy)/(dx)=sqrt(4-y^2)(-2

**6.** Find the general solution of the differential equation

$$\left(x^3 + x^2 + x + 1\right)\frac{dy}{dx} = 2x^2 + x.$$

**7.** Find the general solution of the differential equation

$$\frac{dy}{dx} = \frac{1 + y^2}{1 + x^2}.$$

**8.** Find the general solution of the differential equation

$$\log\left(\frac{dy}{dx}\right) = (ax + by).$$

**9.** Find the general solution of the differential equation

$$\sqrt{1 + x^2 + y^2 + x^2y^2} + xy\frac{dy}{dx} = 0.$$

**10.** Find the general solution of the differential equation

$$(x \cos y)dy = e^x(x \log x + 1)dx.$$

**11.** Find the general solution of the differential equation

$$x\sqrt{1 - y^2}dx + y\sqrt{1 - x^2}dy = 0.$$

**12.** Find the general solution of the differential equation

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

A. $y = C(1 - ay)(a + x)$

B. $y = C(1 + ay)(a + x)$

C. $y = C(a + x)$

D. $y = C(1 - ay)$

**Answer: A**

**13.** Find the general solution of the differential equation
$$(\sqrt{a + x})\frac{dy}{dx} + x = 0.$$

**14.** Find the general solution of the differential equation
$$(x\cos y)dy = e^x(x\log x + 1)dx.$$

**15.** Solve the differential equation

$$\frac{dy}{dx} = \frac{e^x \left( \sin^2 x + \sin 2x \right)}{y(2 \log y + 1)}.$$

**16.** Solve the differential equation

$$(1 + x)\left(1 + y^2\right) dx + (1 + y)\left(1 + x^2\right) dy = 0.$$

**17.** Solve the differential equation

$$\operatorname{cosec} x \, \log y \frac{dy}{dx} + x^2 y^2 = 0.$$

**18.** Show that the general solution of the differentia equation $\dfrac{dy}{dx} + \dfrac{y^2 y + 1}{x^2 + x + 1} = 0$ is given by $x + y + 1 = A(1 - x - y - 2xy)$ where A is a parameter.

**19.** Solve the differential equation $x\left(1 + y^2\right)dx - y\left(1 + x^2\right)dy = 0$, given that $y = 0$, when

**20.** Find the particular solution of the differential equation $xy\dfrac{dy}{dx} = (x + 2)(y + 2)$, it being given that y = -1 when x = 1.

**21.** Find the particular solution of the differential equation $x\left(x^2 - 1\right)\dfrac{dy}{dx} = 1$, it being given that $y = 0$ when $x = 2$.

A. $y = \dfrac{1}{2}\log\left|\dfrac{4\left(x^2 - 1\right)}{x^2}\right|$,

B. $y = \dfrac{1}{2}\log\left|\dfrac{7\left(x^2 - 1\right)}{3x^2}\right|$,

C. $y = \dfrac{1}{2}\log\left|\dfrac{4\left(x^2 - 1\right)}{3x^2}\right|$,

D. $y = \log\left|\dfrac{4\left(x^2 - 1\right)}{3x^2}\right|$,

**Answer: C**

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**22.** find the particular solution satisfying the given condition, for the following differential equation: $(x + 1)\dfrac{dy}{dx} = 2e^{-y} - 1$ given that $y = 0$ when $x = 0$

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**23.** Solve the differential equation

$(1 + y^2)(1 + \log x)dx + xdy = 0$, it being given that y = 1 when x = 1

**24.** Find the particular solution of the differential equation

$(1 + e^{2x})dy + (1 + y^2)e^x dx = 0$, given that $y = 1$ when $x = 0$.

A. $\tan^{-1} y + \tan^{-1} e^x = \dfrac{\pi}{4}$

B. $\tan^{-1} y + \tan^{-1} e^x = \dfrac{\pi}{2}$

C. $\tan^{-1} y + \tan^{-1} x = \dfrac{\pi}{2}$

D. $\tan^{-1} y + \tan^{-1} e^x = (\pi)$

**Answer: B**

**25.** Find the equation of the curve that passes through the point (1, 2) and satisfies the differential equation $\dfrac{dy}{dx} = \dfrac{-2xy}{(x^2+1)}$.

**26.** Find the equation of a curve, passes through $(-2, 3)$ at which the slope of tangent at any point $(x, y)$ is $\dfrac{2x}{y^2}$.

**27.** In a bank, principal increases continuously at the rate of 5% per year. In how many years Rs 1000 double itself?

**Exercise 19 A**

**1.** Find the general solution of each of the following differential equations:

$$\frac{dy}{dx} = \left(1 + x^2\right)\left(1 + y^2\right)$$

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**2.** Find the general solution of each of the following differential equations:

$$x^4 \frac{dy}{dx} = -y^4$$

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**3.** Find the general solution of each of the following differential equations:

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

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**4.** Find the general solution of each of the following differential equations:

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

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**5.** Find the general solution of each of the following differential equations:

$$(x - 1)\frac{dy}{dx} = 2x^3 y$$

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**6.** Find the general solution of each of the following differential equations:

$$\frac{dy}{dx} = e^{x+y}$$

**7.** Find the general solution of each of the following differential equations:

$$\left(e^x + e^{-x}\right)dy - \left(e^x - e^{-x}\right)dx = 0$$

**8.** Find the general solution of each of the following differential equations:

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

**9.** Find the general solution of each of the following differential equations:

$$e^{2x-3y}dx + e^{2y-3x}dy = 0$$

**10.** Find the general solution of each of the following differential equations:

$$e^x \tan y dx + (1 - e^x)\sec^2 y dy = 0$$

**11.** Find the general solution of the differential equations

$$\sec^2 x \tan y dx + \sec^2 y \tan x dy = 0$$

**12.** Find the general solution of each of the following differential equations:

$$\cos x (1 + \cos y) dx - \sin y (1 + \sin x) dy = 0$$

A. $(1 + \sin x)(1 + \cos y) = C$

B. $(1 - \sin x)(1 + \cos y) = C$

C. $(1 - \sin x)(1 - \cos y) = C$

D. $(1 + 2\sin x)(3 + \cos y) = C$

**Answer: A**

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**13.** For each of the folowing differential equations, find a particular

solution satisfying the given condition:

$\cos\left(\dfrac{dy}{dx}\right) = a, \quad \text{where} \quad a \in R \text{ and } y = 2 \text{ when } x = 0.$

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**14.** For each of the folowing differential equations, find a particular

solution satisfying the given condition:

$$\frac{dy}{dx} = -4xy^2, \quad \text{it being given that} \ y = 1 \ \text{when} \ x = 0.$$

**15.** For each of the folowing differential equations, find a particular solution satisfying the given condition:

$$x\,dy = \left(2x^2 + 1\right)dx(x \neq 0), \quad \text{given that} \ y = 1 \ \text{when} \ x = 1.$$

**16.** For each of the folowing differential equations, find a particular solution satisfying the given condition:

$$\frac{dy}{dx} = y\tan x, \quad \text{it being given that} \ y = 1 \ \text{when} \ x = 0.$$

**Exercise 19 B**

**1.** Find the general solution of each of the following differential equations:

$$\frac{dy}{dx} = \frac{x - 1}{y + 2}$$

**2.** Find the general solution of each of the following differential equations:

$$\frac{dy}{dx} = \frac{x}{(x^2 + 1)}$$

**3.** Find the general solution of each of the following differential equations:

$$\frac{dy}{dx} = (1 + x)(1 + y^2)$$

**4.** Find the general solution of each of the following differential equations:

$$\left(1 + x^2\right)\frac{dy}{dx} = xy$$

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**5.** Find the general solution of each of the following differential equations:

$$\frac{dy}{dx} + y = 1(y \neq 1)$$

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**6.** Find the general solution of each of the following differential equations:

$$\frac{dy}{dx} + \sqrt{\frac{1 - y^2}{1 - x^2}} = 0$$

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**7.** Find the general solution of each of the following differential equations:

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

**8.** Find the general solution of each of the following differential equations:

$$x^2(y+1)dx + y^2(x-1)dy = 0$$

**9.** Find the general solution of each of the following differential equations:

$$y(1-x^2)\frac{dy}{dx} = x(1+y^2)$$

**10.** Find the general solution of each of the following differential equations:

$$y \log y \, dx - x \, dy = 0$$

**11.** Find the general solution of each of the following differential equations:

$$x\left(x^2 - x^2 y^2\right) dy + y\left(y^2 + x^2 y^2\right) dx = 0$$

**12.** Find the general solution of each of the following differential equations:

$$\left(1 - x^2\right) dy + xy(1 - y) dx = 0$$

**13.** Find the general solution of each of the following differential equations:

$$\left(1 - x^2\right)(1 - y)dx = xy(1 + y)dy$$

**14.** Find the general solution of each of the following differential equations:

$$(y + xy)dx + \left(x - xy^2\right)dy = 0$$

**15.** Find the general solution of each of the following differential equations:

$$\left(x^2 - yx^2\right)dy + \left(y^2 + xy^2\right)dx = 0$$

**16.** Find the general solution of each of the following differential equations:

$$\left(x^2 y - x^2\right)dx + \left(xy^2 - y^2\right)dy = 0$$

**17.** Find the general solution of each of the following differential equations:

$$x\sqrt{1 + y^2}\,dx + y\sqrt{1 + x^2}\,dy = 0$$

**18.** Find the general solution of each of the following differential equations:

$$\frac{dy}{dx} = e^{x+y} + x^2 e^y$$

**19.** Find the general solution of each of the following differential equations:

$$\frac{dy}{dx} = \frac{3e^{2x} + 3e^{4x}}{e^x + e^{-x}}$$

**20.** Find the general solution of each of the following differential equations:

$$3e^x \tan y \, dx + (1 - e^x)\sec^2 y \, dy = 0$$

**21.** Find the general solution of each of the following differential equations:

$$e^y \left(1 + x^2\right) dy - \frac{x}{y} dx = 0$$

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**22.** Find the general solution of each of the following differential equations:

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

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**23.** Find the general solution of each of the following differential equations:

$$\left(e^y + 1\right)\cos x dx + e^y \sin x dy = 0$$

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**24.** Find the general solution of each of the following differential equations:

$$\frac{dy}{dx} + \frac{xy+y}{xy+x} = 0$$

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**25.** Find the general solution of each of the following differential equations:

$$\sqrt{1-x^4}\,dy = x\,dx$$

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**26.** Find the general solution of each of the following differential equations:

$$\operatorname{cosec} x \log y \frac{dy}{dx} + x^2 y = 0$$

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**27.** Find the general solution of each of the following differential equations:

$$ydx + \left(1 + x^2\right)\tan^{-1}xdy = 0$$

**28.** Find the general solution of each of the following differential equations:

$$\frac{1}{x} \cdot \frac{dy}{dx} = \tan^{-1}x$$

**29.** Find the general solution of each of the following differential equations:

$$e^x\sqrt{1 - y^2}dx + \frac{y}{x}dy = 0$$

**30.** Find the general solution of each of the following differential equations:

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

**31.** Find the general solution of each of the following differential equations:

$$(\cos x)\frac{dy}{dx} + \cos 2x = \cos 3x$$

**32.** Find the general solution of each of the following differential equations:

$$\frac{dy}{dx} + \frac{(1 + \cos 2y)}{(1 - \cos 2x)} = 0$$

**33.** Find the general solution of each of the following differential equations:

$$\frac{dy}{dx} + \frac{\cos x \sin y}{\cos y} = 0$$

**34.** Find the general solution of each of the following differential equations:

$$\cos x(1 + \cos y)dx - \sin y(1 + \sin x)dy = 0$$

**35.** Find the general solution of each of the following differential equations:

$$\sin^3 x\, dx - \sin y\, dy = 0$$

**36.** Find the general solution of each of the following differential equations:

$$\frac{dy}{dx} + \sin(x + y) = \sin(x - y)$$

**37.** Find the general solution of each of the following differential equations:

$$\frac{1}{x}\cos^2 y\, dy + \frac{1}{y}\cos^2 x\, dx = 0$$

**38.** Find the general solution of each of the following differential equations:

$$\frac{dy}{dx} = \sin^3 x \cos^2 x + xe^x$$

**39.** Find the particular solution of the differential equation

$$\frac{dy}{dx} = 1 + x + y + xy, \text{ given that y = 0 when x = 1.}$$

**40.** Find the particular solution of the differential equation

$$x\left(1 + y^2\right)dx - y\left(1 + x^2\right)dy = 0, \text{ given that y = 1 when x = 0.}$$

**41.** Find the particular solution of the differential equation $\dfrac{\log(dy)}{dx} = 3x + 4y$ given that $y = 0$ when $x = 0$.

**42.** Solve the differential equation

$(x^2 - yx^2)\,dy + (y^2 + x^2 y^2)\,dx = 0,$ given that y = 1 when x = 1.

A. $\log|2y| + \dfrac{1}{y} + \dfrac{1}{x} - x = 1$

B. $\log|3y| + \dfrac{1}{y} + \dfrac{1}{x} - x = 1$

C. $\log|x| + \dfrac{1}{y} + \dfrac{1}{x} - x = 1$

D. $\log|y| + \dfrac{1}{y} + \dfrac{1}{x} - x = 1$

**Answer: D**

**43.** Find the particular solution of the differential equation

$e^x\sqrt{1 - y^2}\,dx + \dfrac{y}{x}\,dy = 0$, given that $y = 1$ when $x = 0$

**44.** Find the particular solution of the differential equation

$\dfrac{dy}{dx} = \dfrac{x(2\log x + 1)}{(\sin y + y\cos y)}$, given that $y = \dfrac{\pi}{2}$ when $x = 1$.

**45.** Solve the differential equation

$\dfrac{y}{dx} = y\sin 2x$, given that $y(0) = 1$.

**46.** Solve the differential equation

$(x + 1)\dfrac{dy}{dx} = 2xy$, given that $y(2) = 3$.

**47.** Solve $\dfrac{dy}{dx} = x(2\log x + 1)$, given that $y = 0$ when $x = 2$.

**48.** Solve

$(x^3 + x^2 + x + 1)\dfrac{dy}{dx} = 2x^2 + x$, given that $y = 1$ when $x = 0$.

**49.** Solve $\dfrac{dy}{dx} = y\tan x$, given that $y = 1$ when $x = 0$.

**50.** Solve $\dfrac{dy}{dx} = y^2 \tan 2x$, given that $y = 2$ when $x = 0$.

**51.** Solve $\dfrac{dy}{dx} = y\cot 2x,$ given that $y = 2$ when $x = \dfrac{\pi}{4}.$

**52.** Solve

$\left(1 + x^2\right)\sec^2 y\,dy + 2x\tan y\,dx = 0,$ given that $y = \dfrac{\pi}{4}$ when $x = 1$

.

**53.** Find the equation of the curve passing through the point $\left(0, \dfrac{\pi}{4}\right)$ whose differential equation is

$s\in$ $x$ $\cos$ $y$ $dx$ $+$ $\cos$ $x$ $s\in$ $y$ $dy$ $=$ $0$

.

**54.** Find the equation of a curve which passes through the origin and whose differential equation is $\dfrac{dy}{dx} = e^x \sin x$.

**55.** Find the equation of the curve passing through the point (0, -2) given that at any point $(x, y)$ on the curve the product of the slope of its tangent and $y$ coordinate of the point is equal to the x-coordinate of the point.

**56.** A curve passes through the point (-2, 1) and at any point (x, y) of the curve, the slope of the tangent is twice the slope of the line

segment joining the point of contact to the point (-4, -3). Find the equation of the curve.

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**57.** In a bank principal increases at the rate of r% per year. Find the value of r if Rs. 100 double itself in 10 years $\left( (\log)_e 2 = 0.6931. \right)$

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**58.** In a bank, principal increases continuously at the rate of 5% per year. An amountof Rs 1000 is deposited with this bank, how much will it worth after 10 years $\left( e^{0.5} = 1.648 \right)$

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**59.** The volume of spherical balloon being inflated changes at a constant rate. If initially its radius is 3 units and after 3 seconds it is 6 units. Find the radius of balloon after t seconds.

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**60.** In a culture the bacteria count is 100000. The number is increased by 10% in 2 hours. In how many hours will the count reach 200000, if the rate of growth of bacteria is proportional to the number present.

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