CHAPTER-9

DIFFERENTIAL EQUATIONS

01 MARK TYPE QUESTIONS

Q. NO	**QUESTION**	**MARK**
1.	Solution of differential equation $xdy - ydx = Q$ represents: (a) a rectangular hyperbola (b) parabola whose vertex is at the origin (c) straight line passing through the origin (d) a circle whose centre is at the origin	1
2.	Given the differential equation $\frac{dy}{dx} = \frac{6x^2}{2y+cosy}$ y(1) = π (a) Solution is $y^2 - siny = -2x^3 + c$ (b) Solution of $y^2 + siny = 2x^3 + c$ (c) $C = \pi^2 + 2$ (d) $C = \pi^2 - 2$	1
3.	The differential equation of all parabolas whose axis of symmetry is along the axis of the x-axis is of order (a) 3 (b) 1 (c) 2 (d) none of these	1
4.	The degree of the equation satisfying the relation $\sqrt{1+x^2} + \sqrt{1+y^2} = \lambda x(\sqrt{1+y^2} - y(\sqrt{1+x^2}$ (a) 1 (b) 2 (C) 3 (d)4	1
5.	The order and degree of the differential equation $\left(\frac{d^2y}{dx^2}\right) + \left(\frac{dy}{dx}\right)^{\frac{1}{4}} + x^{\frac{1}{5}} = 0$ Respectively are (a) 2 and not defined (b) 2 and 2 (c)2 and 3 (d)3 and 3	1
6.	Integrating factor of the differential equation $\frac{dy}{dx} + ytanx - secx = 0$ is (a) $cosx$ (b) $secx$ (c) e^{cosx} (d) e^{secx}	1
7.	The number of arbitrary constants in the particular solution of a differential equation of third order is: (a) 3 (b) 2	1

	(c) 1 (d) 0	
8.	The differential equation satisfied by $y = \frac{A}{x} + B$ is (A, B are parameters) (a) $x^2y_1 = y$ (b) $xy_1 + 2y_2 = 0$ (c) $xy_2 + 2y_1 = 0$ (d) none	1
9.	The curve for which the slope of the tangent at any point is equal to the ratio of the abscissa to the ordinate of the point is: (a)Ellipse (b)Parabola (C) Circle (d) Rectangular hyperbola	1
10.	The order of differential equations of all circles of given radius 4 (a) 3 (b) 2 (c) 1 (d) 0	1
11.	The differentilequation y log y dx – xdy =0 is (i) variable separable differential equation (ii) homogeneous differential equation (iii)First order linear differential equation (iv) none of these	1
12.	The integrating factor of the differential equation $x\frac{dy}{dx} + y = x^3$ **is** (i) x (ii) logx (iii) i/x (iv0 none of these	1
13.	The degree of the differential equation $x^2+(\frac{dy}{dx})^2=5$ i (i) 2 (ii) 3 iii) 1 (iv)none of these	1
14.	A solution of the differential equation $(\frac{dy}{dx})^2-x\frac{dy}{dx}+ y = 0$ is (i)y=2 (ii) y=2x (iii) y=2x-4 (iv)none of these	1
15.	The integrating factor of $\frac{dy}{dx}- y=1$ is (i) e^x (ii) e^{-x}(iii) $-e^{-x}$ (iv) none of these	1
16.	The sum of the order and degree of the differential equation $\frac{d^2y}{dx^2}+\left(\frac{dy}{dx}\right)^3$ =siny is (i)1 (ii)2 (iii) 3 (iv) 4	1
17.	What is the product of the order and degree of the differential equation $\frac{d^2y}{dx^2} siny+\left(\frac{dy}{dx}\right)^3 cosy = \sqrt{y}$	1

	(i)3 (ii) 2 (iii) 6 (iv) not defined	
18.	The solution of the differential equation $2x\frac{dy}{dx}$- y = 3 represents a family of (i) Straight lines (ii) circles (iii) parabolas (iv) ellipses	1
19.	The general solution of the differential equation xdy –$(1+x^2)$ dx=x is (i)$y= 2x+ x^3/3 + C$ (ii) $y= 2\log x+ x^3/2 + C$ (iii)$y= 2x+ x^2/3 + C$ $y= x^2/2 + C$ (iv) none of these	1
20.	The solution of $\frac{dy}{dx}$- y = 1 , y(0) = 1 is given by (i)xy=-e(ii)xy=$-e^{-x}$ (iii)xy=-1 (iv) $y=2e^x – 1$	1
21.	The degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^3+\left(\frac{dy}{dx}\right)^2+\sin\left(\frac{dy}{dx}\right)+1=0$, is a)3 b)2 c)1 d)not defined	1
22.	The degree of the differential equation $x=1+\frac{dy}{dx}+\frac{1}{2!}\left(\frac{dy}{dx}\right)^2+\frac{1}{3!}\left(\frac{dy}{dx}\right)^3+\ldots\ldots\ldots\ldots$,is a)3 b)1 c)not defined d)none of these	1
23.	The order of the differential equation $\left(\frac{d^2r}{dt^2}\right)^2+3\left(\frac{dr}{dt}\right)^3+4=0$ is a)2 b)1 c)3 d)4	1
24.	The differential equation $\left(\frac{d^2y}{dx^2}\right)^{\frac{2}{3}}=\left(y+\frac{dy}{dx}\right)^{\frac{1}{2}}$ is of a)second order ,fourth degree b)first order, fourth degree c)second order, third degree d)second order ,second degree	1
25.	The number of arbitrary constants in the general solution of a differential equation of fourth order are a)0 b)2 c)3 d)4	1
26.	The order of the differential equation whose general solution is given by $y=(c_1+c_2)\sin(x+c_3) - c_4e^{x+c_5}$ is a)5 b)4 c)3 d)2	1
27.	The solution of the differential equation $\frac{dy}{dx}+\sqrt{\frac{1-y^2}{1-x^2}}=0$ is	1

	a) $\tan^{-1} x + \cot^{-1} x = C$ b) $\sin^{-1} x + \sin^{-1} y = C$ c) $\sec^{-1} x + cosec^{-1} x = C$ d) none of these	
28.	The number of arbitrary constants in the particular solution of a differential equation of third order are a)3 b)2 c)1 d)0	1
29.	Which of the following is a homogeneous differential equation? (A) (4x+ 6y+ 5) dy– (3y+ 2x+ 4) dx= 0 (B) $(xy)dx - (x^3 + y^3)\, dy = 0$ (C) $(x^3 + 2y^2)\, dx + 2xy\, dy = 0$ (D) $y^2 dx + (x^2 - xy - y^2)dy = 0$	1
30.	The Integrating Factor of the differential equation $x\frac{dy}{dx} - y = 2x^2$ is (A) e^{-x} (B) e^{-y} (C)1/x (D) x.	1
31.	The sum of order and degree of the differential equation $x^3\left(\frac{d^2y}{dx^2}\right)^2 + x\left(\frac{dy}{dx}\right)^4 = 0$ is (a) 6 (b) 2 (c) 4 (d) 3	1
32.	The order and degree of the differential equation $\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^{1/4} + x^{1/5} = 0$ respectively are (a) 2 and 4 (b) 2 and 2 (c) 2 and 3 (d) 3 and 3	1
33.	Which of the following is a second order differential equation? (a) $(y')^2 + x = y^2$ (b)$y'y'' + y = sinx$ (c)$y''' + (y'')^2 + y = 0$ (d) $y' = y^2$	1
34.	The numbers of arbitrary constant in the general solution of a differential equation of fourth order are: (a) 0 (b) 2 (c) 3 (d) 4	1
35.	The numbers of arbitrary constant in the particular solution of a differential equation of second order are: (a) 0 (b) 2 (c) 3 (d) 4	1
36.	A differential equation of the form $\frac{dy}{dx} = F(x,y)$ where $F(x,y)$ is a homogeneous function of degree zero. Differential equation of the form $\frac{dy}{dx} = f(\frac{x}{y})$ is a homogeneous differential equation of degree : (a) 0 (b) 1 (c) 2 (d) not defined	1
37.	The integrating factor of differential equation $\cos x\frac{dy}{dx} + ysinx = 1$ is (a) cos x (b) tan x (c) sec x (d) sin x	1
38.	The solution of differential equation x dy-y dx=0 represents (a) a rectangular hyperbola (b) parabola whose vertex is at origin (c) straight line passing through origin (d) a circle whose centre is at origin	1
39.	A function F(x,y) is a homogeneous function of degree n,if (a) $f(x,y) = x^n f\left(\frac{y}{x}\right)$ (b) $f(x,y) = y^n g\left(\frac{x}{y}\right)$	1

	(c) Both a and b (d) $f(x,y) = x^{-n} f\left(\frac{y}{x}\right)$	
40.	For what value of n is the following a homogeneous differential equation :$\frac{dy}{dx} = \frac{x^3 - y^n}{x^2y + xy^2}$ (a) 4 (b) 3 (c) 2 (d) 1	1
41.	The order and degree of the differential equation $x^2 \frac{d^2y}{dx^2} = \left\{1 + \left(\frac{dy}{dx}\right)^2\right\}^4$ is A. 1, 1 B. 2, 4 C. 2, 1 1, 4	1
42.	The order and degree of the differential equation $x^3 \left(\frac{d^2y}{dx^2}\right)^2 + x\left(\frac{dy}{dx}\right)^4 = 0$ is A. 2, 1 B. 2, 2 C. 4, 2 2, 2	1
43.	The degree of the differential equation $\frac{d^2y}{dx^2} + x\left(\frac{dy}{dx}\right)^2 = 2x^2 \log\left(\frac{d^2y}{dx^2}\right)$ is A. 2 B. 1 C. Not Defined 3	1
44.	The order and degree of the differential equation $\left(\frac{d^4y}{dx^4}\right)^2 = \left\{x + \left(\frac{dy}{dx}\right)^2\right\}^3$ is A. 2, 2 B. 2, 4 C. 2, 6 4, 2	1
45.	The sum of the degree and the order of the following differential equation: $\frac{d}{dx}\left[\left(\frac{d^2y}{dx^2}\right)^4\right] = 0$ is A. 6 B. 3 C. 5 4	1
46.	The sum of the order and degree of the following differential equation: $y = x\left(\frac{dy}{dx}\right)^3 + \frac{d^2y}{dx^2}$ is A. 5 B. 4 C. 3 2	1
47.	The integrating factor of the differential equation $x\frac{dy}{dx} - 2y = 2x^2$ is A. $\frac{1}{x}$ B. $\frac{1}{x^2}$ C. lnx e^x	1
48.	The integrating factor of the differential equation $(y - x)dy = (1 + y^2)dx$ is A. $e^{\tan^{-1}x}$ B. $e^{\tan^{-1}y}$ C. $\tan^{-1}x$ $\tan^{-1}y$	1
49.	The number of arbitrary constants in the general solution of a fourth order differential	1

	equation is A. 0 B. 2 C. 3 4	
50.	The number of arbitrary constants in the particular solution of a fourth order differential equation is A. 0 B. 2 C. 3 4	1
51.	Determine the order of differential equation $$\frac{d^4y}{dx^4} + \tan(y'') = 5$$ (A) 4 (B) 2 (C) 1 (D) Not Defined	1
52.	Check which of the given function is a solution of the following differential equation $y'' - y' = 0$ (A) $y = \sqrt{1 + x^2}$ (B) $y = e^x + 1$ (C) $xy = \log y + C$ (D) $y - \cos y = x$	1
53.	The number of arbitrary constants in the general solution of a differential equation of third order are 0 (B) 2 (C) 4 (D) 3	1
54.	Find the degree of the following differential equation $\left(\frac{d^2y}{dx^2}\right)^2 + \cos\left(\frac{dy}{dx}\right) = 0$ (A) 2 (B) 1 (C) (D) Not Defined	1
55.	A homogeneous differential equation of the form $\frac{dy}{dx} = f(\frac{y}{x})$ can be solved by making the substitution (A) $y = vx$ (B) $v = yx$ (C) $x = vy$ (D) $y = v$	1
56.	The Integrating factor of the differential equation $(1 + x^2)\frac{dy}{dx} + 2xy = \frac{1}{1+x^2}$ is (A) $1 - x^2$	1

	(B)$\frac{1}{1+x^2}$ (C) $1+x^2$ (D)e^{1+x^2}	
57.	The general solution of the differential equation $e^x dy + (ye^x + 2x)dx = 0$ is (A)$xe^y + x^2 = C$ (B) $xe^y + y^2 = C$ (C) $ye^x + x^2 = C$ (D) $ye^y + x^2 = C$	1
58.	The Integrating factor of the differential equation $x\frac{dy}{dx} - y = 2x^2$ is (A) e^{-x} (B) e^{-y} (C) $\frac{1}{x}$ (D) x	1
59.	The general solution of the differential equation $\frac{dy}{dx} = e^{x+y}$ is (A)$e^x + e^{-y} = C$ (B) $e^x + e^y = C$ (C) $e^{-x} + e^y = C$ (D) $e^{-x} + e^{-y} = C$	1
60.	The number of arbitrary constants in the particular solution of a differential equation of fifth order are 5 (B) 2 (C) 3 (D) 0	1
61.	The order of the differential equation $2x^2d^2y/dx^2$ -3dy/dx+y=0 is (a)2 (b)1 (c)0 (d)not defined	1
62.	The degree of differential equation $1+(\frac{dy}{dx})^2 = x$ is (a)1 (b)2 (c)3 (d)not defined	1
63.	The order and degree of the differential equation $X\sqrt{1-y}^2dx + y\sqrt{1-x}^2dy$ = 0 are respectively. (a)1 and 1 (b)1 and 2	1

	(c)2 and 1 (d)1 and 3	
64.	The order and degree (if defined) of the differential equation $d^2y/dx^2 + x(d\frac{dy}{dx})^2 = 2x^2 \log(d^2y/dx^2)$ (a)2 and 3 (b)2 and 1 (c)2 and not defined (d) None of these	1
65.	The number of arbitrary constants in the particular solution of a differential equation of second order is(are) (a)0 (b)1 (c)2 (d)3	1
66.	The differential equation $Y\frac{dy}{dx} + x = C$ represents (a)family of hyperbolas (b)family of parabolas (c)family of ellipses (d)family of circles	1
67.	Which of the following is not a homogeneous function of x and y (a)$x^2 + 2xy$ (b)$2x – y$ (c)$\cos^2(\frac{y}{x}) + \frac{y}{x}$ (d)sinx -cosy	1
68.	If the slope of the tangent to the curve at any point P(x,y)is $\frac{y}{x} - \cos^2\frac{y}{x}$, then the equation of a curve passing through $(1,\frac{\pi}{4})$ is (a)$\tan(\frac{y}{x}) + \log x = 1$ (b)$\tan(\frac{y}{x}) + \log y = 1$ (c)$\tan(\frac{x}{y}) + \log x = 1$ (d)$\tan(\frac{x}{y}) + \log y = 1$	1 1
69.	The integrating factor of $(\sin x)\frac{dy}{dx} + (2\cos x)y = \sin x \cos x$ is (a)secx (b)$(\sin x)^2$ (c)$(\text{cosec}\, x)^2$ (d)$(\tan x)^2$	1
70.	The general solution of the differential equation $e^{2x}\frac{dy}{dx} + 3e^{2x}y = 1$ is (a)$ye^{3x} = e^{x} + C$ (b)$ye^{3x} = e^{-x} + C$ (c)$ye^{3x} = -e^{x} + C$ (d)$ye^{x} = e^{3x} + C$	1

ANSWERS:

Q. NO	ANSWER	MARKS
1.	c	1
2.	b	1
3.	c	1
4.	a	1
5.	a	1
6.	b	1
7.	d	1
8.	c	1
9.	d	1
10.	b	1
11.	i	1
12.	i	1
13.	iii	1
14.	iii	1
15.	ii	1
16.	iii	1
17.	ii	1
18.	i	1
19.	iv	1
20.	iv	1
21.	D	1
22.	C	1
23.	A	1
24.	A	1
25.	D	1
26.	C	1
27.	B	1
28.	D	1
29.	D	1
30.	C	1
31.	C	1
32.	A	1
33.	B	1
34.	D	1
35.	A	1
36.	B	1
37.	C	1
38.	C	1
39.	C	1
40.	B	1
41.	$\text{Order} = 2, \text{Degree} = 1$	1
42.	$\text{Order} = 2, \text{Degree} = 2$	1
43.	$\text{Degree} = \text{Not Defined}$	1

44.	Order $= 4$, Degree $= 2$	1
45.	$\frac{d}{dx}\left[\left(\frac{d^2y}{dx^2}\right)^4\right] = 0$ $\Rightarrow 4.\left(\frac{d^2y}{dx^2}\right)^3 .\frac{d^3y}{dx^3} = 0$ $\Rightarrow \left(\frac{d^2y}{dx^2}\right)^3 \frac{d^3y}{dx^3} = 0$ Order $= 3$, Degree $= 1$ Order $+$ Degree $= 3 + 1 = 4$	1
46.	Order $+$ Degree $= 2 + 1 = 3$	1
47.	$x\frac{dy}{dx} - 2y = 2x^2$ $\Rightarrow \frac{dy}{dx} - \frac{2y}{x} = 2x \ldots (i)$ $\frac{dy}{dx} + Py = Q \ldots (ii)$ On comparison, we get $P = -\frac{2}{x}, Q = 2x$ Integrating Factor (I. F) $= e^{\int p dx} = e^{\int \frac{-2dx}{x}} = e^{-2\log\lvert x\rvert} = e^{\log\left\lvert\frac{1}{x^2}\right\rvert} = \frac{1}{x^2}$	1
48.	$(\tan^{-1} y - x)dy = (1 + y^2)dx$ $\Rightarrow (\tan^{-1} y - x) = (1 + y^2)\frac{dx}{dy}$ $\Rightarrow \frac{dx}{dy} = \frac{(\tan^{-1} y - x)}{(1 + y^2)}$ $\Rightarrow \frac{dx}{dy} + \frac{x}{1 + y^2} = \frac{\tan^{-1} y}{1 + y^2} \ldots (i)$ $\frac{dx}{dy} + Px = Q \ldots (ii)$ On comparison, we get $P = \frac{1}{1 + y^2}, Q = \frac{\tan^{-1} y}{1 + y^2}$ Integrating Factor (I. F) $= e^{\int p dy} = e^{\int \frac{dy}{1+y^2}} = e^{\tan^{-1} y}$	1
49.	4	1
50.	0	1
51.	A	1
52.	B	1
53.	D	1
54.	D	1
55.	A	1
56.	C	1
57.	C	1
58.	C	1
59.	A	1
60.	D	1

61.	(a)	1
62.	(b)	1
63.	(a)	1
64.	(c)	1
65.	(a)	1
66.	(d)	1
67.	(d)	1
68.	(a)	1
69.	(b)	1
70.	(a)	1

CHAPTER-9
DIFFERENTIAL EQUATIONS
02 MARKS TYPE QUESTIONS

Q. NO	QUESTION	MARK
1.	Find the differential equation representing the family of curves $y = ae^{2x}$+ 5 constant.	2
2.	Form the differential equation of the family of hyperbolas having foci On x-axis and center at origin..	2
3.	Form the differential equation representing the family of curves y = a sin (x + b), where a ,b are arbitrary constant.	2
4.	Find the solution of dy/dx = 2 $^{y-}$.	2
5.	Find a particular solution satisfying the given condition (X+y)dy + (x-y)dx=0 Y=1 when x=1	2
6.	Given that dy/dx = e −$2y$ and y = 0 when x = 5 Find the value of x when y = 3	2
7.	Solve the differential equation dy/dx + 2xy = y	2
8.	Find the general solution of dy/dx + ay = e^{mx}	2
9.	Verify that the function y = xsinx is a solution of the differential equation x$\frac{dy}{dx}$ = y +x$\sqrt{x^2 - y^2}$.	2
10.	Find the general solution of the differential equation y logy dx – x dy = 0.	2
11.	Show that the differential equation (x– y) $\frac{dy}{dx}$ = (x+ 2y) is homogeneous and solve it.	2
12.	Find the general solution of the differential equation x$\frac{dy}{dx}$ +2y = x^2	2
13.	Find the general solution of the differential equation (x+y) $\frac{dy}{dx}$ =1	2
14.	It is known that, if the interest is compounded continuously, the principal changes at the rate equal to the product of the rate of bank interest per annum and the principal. Let P denotes the principal at any time t and rate of interest be r% per annum. Based on the above information, answer the following questions Find the value of dP/dt	2
15.	If P_0 be the initial principal, then find the solution of differential equation formed in given situation.	2
16.	Polio drops are delivered to 50K children in a district. The rate at which polio drops are given is directly proportional to the number of children who have not been administered the drops. By the end of 2nd week half the children have been given the polio drops. How many will have been given the drops by the end of 3rd week can be estimated using the solution to the differential equation $\boldsymbol{dy/dx}$=k($\mathbf{50}$−**y**) where x denotes the number of weeks and y the number of children who have been given the drops.	

	Based on the above information, answer the following questions	
17.	Find the solution of the differential equation $\boldsymbol{dy/dx}$=k($\mathbf{50}$−$\mathbf{y}$) ?	2
18.	Find the value of c in the particular solution given that y(0)=0 and k=0.049 .	2
19.	Find the general solution of the differential equation $\frac{dy}{dx} = e^{x+y}$.	2
20.	Solve that the differential equation $\frac{dy}{dx} + y = cos\ x\ - sin\ x$.	2
21.	If $y = 5e^{7x} + 6e^{-7x}$, then show that $\frac{d^2y}{dx^2} = 49y$.	2
22.	If $y = -Acos\ (3x) + Bsin\ (3x)$, then show that $\frac{d^2y}{dx^2} = -9y$.	2
23.	Solve the differential equation $cos\left(\frac{dy}{dx}\right) = a, a \in R$	2
24.	Find the general solution of the differential equation $$\frac{dy}{dx} = \frac{1 + y^2}{1 + x^2}$$	2
25.	Find the difference of the order and the degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^2 + \left(\frac{dy}{dx}\right)^3 + x^4 = 0$	2
26.	Find the solution of $\frac{dy}{dx}$=2^{y-x}	2
27.	Find the sum of the order and the degree of the differential equation $$\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^3 = sin\ y$$	2
28.	Find the sum of the order and the degree of the differential equation $$y''' + 2y'' + y' = 0$$	2
29.	Find the solution of the differential equation Log($\frac{dy}{dx}$) = ax + by	2
30.	Find the solution of the differential equation $\frac{dy}{dx}$=x+$\frac{y}{x}$satisfying the condition y(1) = 1.	2
31.	Solve the differential equation (e^x +1)ydy = e^x(y + 1)dx.	2
32.	Solve $\frac{dy}{dx}$+ 2xy = y	2
33.	Find the particular solution of the differential equation $\frac{dy}{dx}$= ytanx,when y(0)=1	2

ANSWERS:

Q. NO	ANSWER	MARKS
1.	dy/dx=2y-10	
2.	Equation of a hyperbola is given by $$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1 \ldots\ldots\ldots\ldots(1)$$ Differentiating both the sides, we get $$\frac{2x}{a^2}-\frac{2yy}{b^2}=0$$ By solving this equation we get $$xy\left(\frac{d^2y}{dx^2}\right)+\ xy^2-yy'=0$$	
3.	Y=asin(x+b) Differentiating w.r.t. x, we get, $$\frac{dy}{dx}=(x+b)\,.1$$ Again differentiating and by solving we get $\frac{d^2y}{dx^2}+\ y=0$	
4.	2^{-x}-2^{-y}=k	
5.	log(x^2+y^2)+2$\frac{y}{x}=\ \frac{\pi}{2}\ log2$	
6.	(e^6+9)/2	
7.	y=-c$e^{(x-x2)}$	
8.	(a+m)ye^{mx}+e^{-ax}	
9.	Given y=xsinx Then $\frac{dy}{dx}$=xcosx+sinx LHS=x$\frac{dy}{dx}$=x(xcosx+sinx). RHS= y +x$\sqrt{x^2-y^2}$=xsinx +x$\sqrt{x^2-x^2sin^2x}$ = x(xcosx+sinx) Therefore y=x.sinx is a solution of x$\frac{dy}{dx}$= y +x$\sqrt{x^2-y^2}$.	2
10.	given y logydx – xdy = 0. We get $\frac{dx}{x}$=$\frac{dy}{ylogy}$ Integrate it, we get General solution y =e^{cx}	2
11.	This is of the form $\frac{dy}{dx}$=g$\left(\frac{y}{x}\right)$. Put y=vx ,then $\frac{dy}{dx}$=v+x$\frac{dv}{dx}$ Gives $\left(\frac{v-1}{v^2+v+1}\right)dv$=$\frac{-dx}{x}$ Integrate it, we get $\frac{1}{2}$log(v^2+v+1)+ $\frac{1}{2}$logx^2=$\sqrt{3}\tan^{-1}\left(\frac{2v+1}{\sqrt{3}}\right)$+c Put v=$\frac{y}{x}$,we get	2

	General solution $\log\|x^2+xy+y^2\|=2\sqrt{3}\tan^{-1}\left(\frac{x+2y}{\sqrt{3}\,x}\right)+c_1$	
12.	ANS:given differential equation $x\frac{dy}{dx}+2y=x^2$ Then $\frac{dy}{dx}+\frac{2}{x}y=x$ The given equ. is a L.D.E. of the type $\frac{dy}{dx}$+Py=Q ,where P=$\frac{2}{x}$ and Q=x IF= $e^{\int\frac{2}{x}dx}=x^2$ solution is given by $yx^2=\int(x)(x^2)dx+c$ General solution $y=x^2/4+cx^{-2}$.	2
13.	ANS:given differential equation is $(x+y)\frac{dy}{dx}=1$ Then $\frac{dx}{dy}-x=y$ The given equ. is a L.D.E. of the type $\frac{dx}{dy}$+Px=Q ,where P=-1 and Q=y IF= $e^{\int -1dy}=e^{-y}$ Solution is given by x.IF=$\int Q\times IF dy$+C $xe^{-y}=\int ye^{-y}dy+C=-ye^{-y}-e^{-y}+C$ Gives general solution $(x+y+1)=c\,e^{y}$.	2
14.	$\frac{dp}{dt}=\frac{Pr}{100}$	2
15.	$log\left(\frac{p}{p_0}\right)=\frac{rt}{100}$	2
16.	$-\log\|50-y\|=kx+C$	2
17.	$log\frac{1}{50}$	2
18.	$y=50(1-e^{-kx})$	2
19.	$\frac{dy}{dx}=e^{x+y}$ $\Rightarrow\frac{dy}{dx}=e^{x}.e^{y}$ $\Rightarrow\frac{dy}{e^y}=e^{x}dx$ $\Rightarrow e^{-y}\,dy=e^{x}dx$ $\Rightarrow\int e^{-y}\,dy=\int e^{x}dx$ $\Rightarrow -e^{-y}=e^{x}+c$	2
20.	$\frac{dy}{dx}+y=\cos x-\sin x\ldots(i)$ $\frac{dy}{dx}+Py=Q\ldots(ii)$ On comparison, we get $P=1,Q=\cos x-\sin x$ Integrating Factor $(\mathrm{I.F})=e^{\int pdx}=e^{\int dx}=e^{x}$ Hence, the $\mathrm{sol^n}$ is : $y\times\mathrm{I.F}=\int Q\times\mathrm{I.F}\,dx$ $\Rightarrow ye^{x}=\int e^{x}(\cos x-\sin x)dx$ $\Rightarrow ye^{x}=e^{x}\cos x+c$ $\left(\text{Applying}\int e^{x}\big(f(x)+f'(x)\big)dx=e^{x}f(x)+c,\text{here},f(x)=\cos x\right)$	2

21.	$y = 5e^{7x} + 6e^{-7x} \ldots (i)$ Differentiating both sides w.r.t. x $\frac{dy}{dx} = 7(5e^{7x} - 6e^{-7x})$ Differentiating both sides w.r.t. x $\frac{d^2y}{dx^2} = 49(5e^{7x} + 6e^{-7x})$ $\Rightarrow \frac{d^2y}{dx^2} = 49y$ (proved)(from (i))	2
22.	$y = -A\cos(3x) + B\sin(3x) \ldots (i)$ Differentiating both sides w.r.t. x $\frac{dy}{dx} = 3(A\sin(3x) + B\cos(3x))$ $\Rightarrow \frac{d^2y}{dx^2} = 9(A\cos(3x) - B\sin(3x))$ $\Rightarrow \frac{d^2y}{dx^2} = -9(-A\cos(3x) + B\sin(3x))$ $\Rightarrow \frac{d^2y}{dx^2} = -9y$ (from (i))	2
23.	$\cos\left(\frac{dy}{dx}\right) = a, a \in \mathbb{R}$ $\Rightarrow \frac{dy}{dx} = \cos^{-1} a$ $\Rightarrow dy = \cos^{-1} a. dx$ $\Rightarrow \int dy = \cos^{-1} a \int dx$ $\Rightarrow y = x \cos^{-1} a + c$	2
24.	$\frac{dy}{dx} = \frac{1+y^2}{1+x^2}$ Separating the variable and integrating both sides, $\int \frac{dy}{1+y^2} = \int \frac{dx}{1+x^2}$ $tan^{-1}y$=$tan^{-1}x$+C, which is the general solution of given equation	2
25.	Order =2, Degree = 2, Difference of order and degree = 0	2
26.	Rewriting the equation as $\frac{dy}{dx} = \frac{2^y}{2^x}$ $\frac{dy}{2^y} = \frac{dx}{2^x}$ Integrating both sides $\int \frac{dy}{2^y} = \int \frac{dx}{2^x}$ $-\frac{2^{-y}}{\log 2} = -\frac{2^{-x}}{\log 2} + C_1$ $2^{-x} - 2^{-y} = C$ Which is the general solution of given equation.	2
27.	Order =2, Degree = 1, Sum of order and degree = 3	2
28.	Order =3, Degree = 1, Sum of order and degree = 4	2

29.	. Given, $\log(\frac{dy}{dx}) = ax + by$ $\frac{dy}{dx} = e^{ax + by}$ [$\because \log_b a = c = a = b^c$] ➢ $\frac{dy}{dx} = e^{ax} \cdot e^{by} = \frac{dy}{e^{by}} = e^{ax}dx$ ➢ $e^{-by}dy = e^{ax}dx$ On integrating both sides, we get $\int e^{-by}dy = \int e^{ax}dx$ ➢ $\frac{e^{-by}}{-b} = \frac{e^{ax}}{a} + C$ [$\because \int e^{ax + b}dx = \frac{e^{ax} + b}{a} + C$] ➢ $\frac{e^{ax}}{a} + \frac{e^{-by}}{b} + C = 0$ Which is required solution	2
30.	Given, equation can be rewritten as $\frac{Dy}{dx} = \frac{1}{x} .y = 1$ Here, $P = -\frac{1}{x}$ and $Q = 1$ $\because$ IF = $e^{\int Pdx} = e^\wedge -\int \frac{1}{x}dx = e^{-\log x} = \frac{1}{x}$ $\because$ Required solution is $Y\left(\frac{1}{x}\right) = \int \frac{1}{x}dx = \log x + C$ [$\because y \cdot IF = \int (Q \cdot IF)dx + C$] Since, y(1) =1 and C = 1 $\because$ y = xlogx + x	2
31.	We have, $(e^x + 1)ydy = e^x(y + 1)dx$ On separating the variables , we get $\frac{y}{y+1}dy = \frac{e^x}{e^x+1}dx$ On integrating both sides, we get $\int \frac{y}{y+1} dy = \int \frac{e^x}{e^x+1}dx$ ➢ $\int y + 1 - \frac{1}{y} + 1dy = \int \frac{e^x}{e^x+1}dx$ ➢ $\int (1 - \frac{1}{y+1})dy = \int \frac{e^x}{e^x+1}dx$ ➢ $y - \log(y+1) = \log(e^x + 1) + C$ which is required solution.	2
32.	Given that, $xdx - ye^y\sqrt{1 + x}^2dy = 0 \Rightarrow xdx = ye^y\sqrt{1 + x}^2dy$ ⇨ $\frac{x}{\sqrt{1+x^\wedge 2}}dx = ye^{dy}$ Integrating both sides,we get $\int x/\sqrt{1 + x}^2dx = \int y \cdot e^y dy$ $\Rightarrow \frac{1}{2}\int 2x/\sqrt{1 + x}^2dx = [y \cdot \int e^\wedge y dy - \int (\frac{d}{dy}(y) \cdot \int e^\wedge y dy)dy]$ Let $I_1 = \int 2x/\sqrt{1 + x}^2dx$ Putting $1 + x^2 = t \Rightarrow 2x\, dx = dt$ [on differentiating] $\because$ $I_1 = \int dt/t^{1/2} = \int t^{-1/2}dt$ $= t^{-1/2+1}/-\frac{1}{2}+1 = t^{-1/2}/\frac{1}{2} = 2t^{1/2}$ $= 2(1+x^2)^{½}$ Now, $½.2(1+x^2)^{½} = y \cdot e^y - e^y + C$ $\Rightarrow$ $(1+x^2)^{1/2} = e^y(y-1) + C$ When x = 0, then y = 1	2

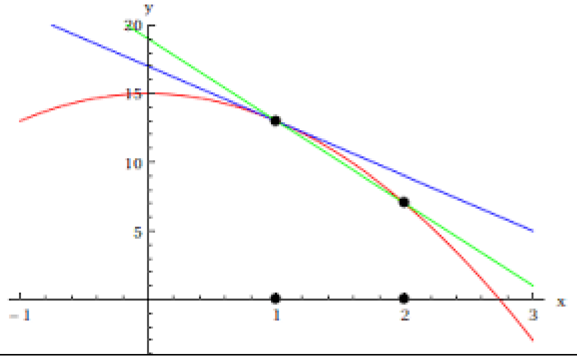
	∴ $(1+0)^{1/2} = e^1(1-1) + C$ $C = 1$ So, required solution is given by $(1+x^2)^{1/2} = e^y(y-1) + 1$	
33.	We have, $\frac{dy}{y}$ = ytanx On separating variable both sides, we get $\frac{dy}{y}$ = tanx dx On intergrating both sides,we get $\int dy/y = \int tanx\ dx$ => logy =logsecx + logC => logy = log(C secx) [∴loga+logb = logab] => y = C secx …(i) Now, it is given that x = 0 and y = 1 ∴ 1 =C sec0 => 1 =C On putting C = 1 in Eq. (i), we get Y = secx. Which is required solution.	2

CHAPTER-9

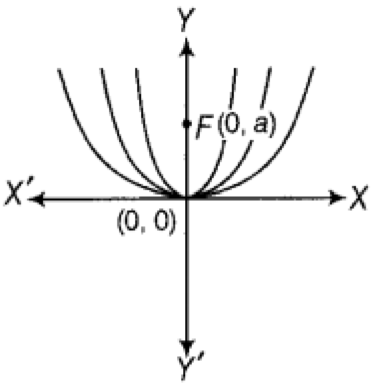
DIFFERENTIAL EQUATIONS

03 MARK TYPE QUESTIONS

Q. NO	QUESTION	MARK
1.	For each of the given differential equation, find a particular solution satisfying the given condition: dy/dx = y tan x ; y = 1 when x = 0	3
2.	Form the differential equation of the family of parabolas having vertex at origin and axis along positive Y-axis.	3
3.	Write the solution of the differential equation $\frac{dy}{dx} = 2^{-y}$.	3
4.	Solve the differential equation $dy/dx + 1 = e^{x+y}$	**3**
5.	Solve: ydx – xdy = x^2 ydx	**3**
6.	Q3 Solve the differential equation $dy/dx = 1 + x + y^2 + xy^2$, when y = 0, x = 0.	**3**
7.	Find the equation of the curve passing through the point (2, 0) whose differential equation is $x(x^2 - 1)\frac{dy}{dx} = 1$	3
8.	Show that the given differential equation is homogeneous $x^2dy+(xy+y^2)dx=0$ and find its particular solution, given that, x= 1 when y = 1	3
9.	Find the particular solution satisfying the given condition: $\frac{dy}{dx}$ +2ytanx= sinx; y=0 when x=$\frac{\pi}{3}$.	3
10.	Find the equation of curve passing through the origin given that the slope of the tangent to the curve at any point (x,y) is equal to the sum of the coordinates of the point.	3
11.	Find the particular solution of the differential equation $2ye^{y/x}dx + (y - 2xe^{\frac{x}{y}})$dy=0 given that x=0 when y=1	3
12.	Find the equation of a curve passing through the point (0,2), given that the sum of the coordinates of any point on the curve exceeds the magnitude of the slope of the tangent to the curve at that point by 5.	3
13.	Solve the differential equation $(y + 3x^2)\frac{dx}{dy} = x$.	3
14.	Find the particular solution of the differential equation $\frac{dy}{dx} = 1 + x^2 + y^2 + x^2y^2$, given that $y = 0$ when $x = 1$.	3
15.	Solve the differential equation $(1 + x^2)dy + 2xydx = cot\ x\ dx$.	3
16.	Verify that the function $y = a\cos x + b\sin x$, where $a , b \in \boldsymbol{R}$ is a solution of the differential equation $\frac{d^2y}{dx^2} + y = 0$	3
17.	Find the general solution of the differential equation $$\frac{dy}{dx} = e^{x+y}$$	3
18.	Find the equation of a curve passing through the point (-2,3), given that the	3

	slope of the tangent to the curve at any point (x,y) is $\frac{2x}{y^2}$ 	
19.	Find the particular solution of the differential equation X dx -ye$^{y}\sqrt{1+x^2}$dy=,given that y=1,when x=0	3
20.	For the differential equation given below , find a particular solution satisfying the given condition $(x+1)\frac{dy}{dx}= 2e^{-y} + 1$; y =0 when x =0.	3
21.	Solve the differential equation $(1+x^2)\frac{dy}{dx}+2xy -4x^2 = 0$ Subject to the initial condition y(0) = 0.	3

ANSWERS:

Q. NO	ANSWER	MARKS
1.	Differentiating equation we get $\frac{dy}{dx} = ytanx$ $\frac{dy}{y} = tanxdx$ Integrating both side and by solving we get ycosx=x Putting x=0 and y = 1 we get $1 \times cos0 = c$ Putting c=1 we get $yosx = 1$ This is the required solution.	
2.	We know that, equation of parabola having vertex at origin and axis along positive Y-axis is $x^2 = day$, where a is the parameter. …(i)  on differentiating equation (1) w.r.t x we get $2x = 4ay'$ $4a = \frac{2x}{y'} \ldots \ldots \ldots \ldots (ii)$ On substituting the value of 4a from Eq. (ii) to Eq. (i), we get $x^2 = \frac{2x}{y'}y$ $=> xy' - 2y = 0, which\ is\ required\ solution.$	
3.	Given differential equation is $\frac{dy}{dx} = 2^{-y}$ On separating the variables, we get $2^y = dx$ On integrating both sides, we get $\int 2^y dy = \int dx$ $\Rightarrow \frac{2^y}{log2} = x + c_1$ $\Rightarrow 2^y = xlog2 + c_1 log2$ $\Rightarrow 2^y = xlog2 + c(c = c_1 log2)$	
4.	$(x-c)e^{(x+y)} +1 = 0$	
5.	$y=kxe^{-x2}/2$	
6.	$y=tan(x+x^2/2)$	

7.	Given differential equation is $x(x^2-1)\frac{dy}{dx}=1$ Then $dy=\frac{dx}{x(x^2-1)}$ Integrate it, we get $y=\frac{1}{2}\log\left(\frac{x^2-1}{x^2}\right)+C$ Substituting y=0 and x=2 we get $c=-\frac{1}{2}log\frac{3}{4}$ Particular solution $y=\frac{1}{2}\log\left(\frac{x^2-1}{x^2}\right)-\frac{1}{2}log\frac{3}{4}$	3
8.	ANS:given differential equation is $x^2dy+(xy+y^2)dx=0$ This is of the form $\frac{dy}{dx}=g\left(\frac{y}{x}\right)$. Put y=vx ,then $\frac{dy}{dx}=v+x\frac{dv}{dx}$ Gives $\left(\frac{1}{v^2+2v}\right)dv=\frac{-dx}{x}$ Integrate it, we get $\log\left\|\left(\frac{v}{v+2}\right)x^2\right\|=\log c^2$ Put $v=\frac{y}{x}$,we get $\frac{x^2y}{2x+y}=A$ When x=1 ,y=1 we get Particular solution $y+2x=3x^2y$.	3
9.	ANS:given $\frac{dy}{dx}$ +2ytanx= sinx The given equ. is a L.D.E. of the type $\frac{dy}{dx}$+Py=Q ,where P=2tanx and Q=sinx IF= $e^{\int 2tanxdx}=\sec^2x$, General solution is given by y.IF=$\int Q\times IFdx+c$ y. $\sec^2x=\int sinx.\sec^2xdx+c$=secx +c put y=0 and $x=\frac{\pi}{3}$ we get c=-2 Particular solution $y=\cos x-2\cos^2x$.	3
10.	$X+y+1=e^x$	3
11.	$2e^{\frac{x}{y}}+log\|y\|=2$	3
12.	$y=4-x-2e^x$	3
13.	$(y+3x^2)\frac{dx}{dy}=x$ $\Rightarrow\frac{dy}{dx}=\frac{y+3x^2}{x}$ $\Rightarrow\frac{dy}{dx}-\frac{y}{x}=3x\ldots(i)$ $\frac{dy}{dx}+Py=Q\ldots(ii)$ On comparison, we get $P=-\frac{1}{x},Q=3x$ Integrating Factor (I. F) $=e^{\int pdx}=e^{\int-\frac{dx}{x}}=e^{-\log\|x\|}=e^{\log\left\|\frac{1}{x}\right\|}=\frac{1}{x}$ Hence, the sol^n is : $y\times\text{I.F}=\int Q\times\text{I.F}\,dx$ $\Rightarrow\frac{y}{x}=\int 3x.\frac{1}{x}dx$ $\Rightarrow\frac{y}{x}=\int 3dx$ $\Rightarrow\frac{y}{x}=3x+c$	

14.	$\frac{dy}{dx} = 1 + x^2 + y^2 + x^2y^2$ $\Rightarrow \frac{dy}{dx} = (1 + x^2) + y^2(1 + x^2)$ $\Rightarrow \frac{dy}{dx} = (1 + x^2)(1 + y^2)$ $\Rightarrow \frac{dy}{1 + y^2} = (1 + x^2)dx$ $\Rightarrow \int \frac{dy}{1 + y^2} = \int (1 + x^2)dx$ $\Rightarrow \tan^{-1} y = x + \frac{x^3}{3} + c$ It is given that $y = 0$ when $x = 1$ $\therefore\ 0 = 1 + \frac{1}{3} + c$ $\Rightarrow c = -\frac{4}{3}$ Hence, the complete sol^{n} is : $$\tan^{-1} y = x + \frac{x^3}{3} - \frac{4}{3}$$	
15.	$(1 + x^2)dy + 2xydx = \cot x\, dx$ $\Rightarrow (1 + x^2)\frac{dy}{dx} + 2xy = \cot x$ $\Rightarrow \frac{dy}{dx} + \frac{2xy}{1 + x^2} = \frac{\cot x}{1 + x^2} \dots (i)$ $\frac{dy}{dx} + Py = Q \dots (ii)$ On comparison, we get $P = \frac{2x}{1 + x^2}, Q = \frac{\cot x}{1 + x^2}$ Integrating Factor (I. F) $= e^{\int pdx} = e^{\int \frac{2xdx}{1+x^2}} = e^{\log\|1+x^2\|} = e^{\log\|1+x^2\|}$ $= 1 + x^2$ Hence, the sol^{n} is : $y \times \text{I.F} = \int Q \times \text{I.F}\, dx$ $\Rightarrow y(1 + x^2) = \int \frac{\cot x}{(1 + x^2)}.(1 + x^2)dx$ $\Rightarrow y(1 + x^2) = \int \cot x\, dx$ $$\Rightarrow y(1 + x^2) = \log\|\sin x\| + c$$	
16.	$$y = \text{a} \cos x + b \sin x$$ On differentiating both sides with respect to x, we get $$\frac{dy}{dx} = -a \sin x + b \cos x$$ $$\frac{d^2y}{dx^2} = -a \cos x - b \sin x$$ Now we get $\frac{d^2y}{dx^2} + \ y = -a \cos x - b \sin x + \text{a} \cos x + b \sin x = 0$ Therefore, the given function is a solution of the given differential equation.	3

17.	Given differential equation can be rewritten as $\frac{dy}{dx} = e^x . e^y$ $$e^{-y}dy = e^x dx$$ On integrating both sides, we get $$\int e^{-y}dy = \int e^x dx$$ $$-e^{-y} = e^x + C_1$$ $$e^x + e^{-y} = C$$	3
18.	We know that the slope of the tangent to the curve is given by $\frac{dy}{dx}$ Hence, as per condition $\frac{dy}{dx} = \frac{2x}{y^2}$ The above equation can be rewritten as $$y^2 dy = 2x\, dx$$ On integrating both sides, we get $$\int y^2 dy = \int 2x\, dx$$ $$\frac{y^3}{3} = x^2 + C$$ Substituting x=-2 and y=3 we get C=5 Hence the equation of the required curve is $\frac{y^3}{3} = x^2 + 5 \Rightarrow$ y= $(3x^2 + 15)^{\frac{1}{3}}$	3
19.	Given that, $x dx - y e^y \sqrt{1+x^2}\, dy = 0 \Rightarrow x dx = y e^y \sqrt{1+x^2} dy$ $\Rightarrow \frac{x}{\sqrt{1+x^2}} dx = y e^y dy$ Integrating both sides, we get $\int x/\sqrt{1+x^2} dx = \int y \cdot e^y dy$ $\Rightarrow \frac{1}{2}\int \frac{2x}{\sqrt{1+x^2}} dx = [\, y \cdot \int e^y dy - \int (d/dy(y) \cdot \int e^2 dy) dy]$ Let $I_1 = \int 2x/\sqrt{1+x^2} dx$ Putting $1 + x^2 = t \Rightarrow 2x\, dx = dt$ [on differentiating] $\therefore$ $I_1 = \int \frac{dt}{t^{1/2}} = \int t^{-1/2} dt$ $= \frac{t^{-1/2+1}}{-\frac{1}{2}+1} = \frac{t^{1/2}}{\frac{1}{2}} = 2t^{1/2}$ $= 2(1+x^2)^{1/2}$ Now, $\frac{1}{2} \cdot 2(1+x^2)^{1/2} = y \cdot e^y - e^y + C$ $\Rightarrow$ $(1+x^2)^{1/2} = e^y(y-1) + C$ When x = 0, then y = 1 $\therefore$ $(1+0)^{1/2} = e^1(1-1) + C$ $\Rightarrow$ C = 1 So, required solution is given by $(1+x^2)^{1/2} = e^y(y-1) + 1$	3
20.	Given, differential equation is $(x+1)\frac{dy}{dx} = 2e^{-y} + 1$ $\Rightarrow$ $(x+1)\frac{dy}{dx} = \frac{2+e^y}{e^y}$	3

	=>$\frac{e^y}{e^y+2}$dy = $\frac{dx}{x+1}$ On integrating both sides,we get $\int \frac{e^y}{e^{y+2}}$dy = $\int \frac{dx}{x} + 1$ => log(e^y + 2) = log(x+1) + logC => log(e^y + 2) = logC(x+1) …(i) =>e^y + 2 = C(x+1) Also given y = 0, when x = 0 On putting x = 0 and y = 0 in Eq.(i) we get e^0 + 2 = C(0 + 1) => C = 1 + 2 =3 On putting C in Eq. (i) we get =>e^y + 2 = 3(x+1) =>e^y = 3x +3 -2 =>e^y = 3x + 1 => y = log(3x + 1)	
21.	Given, differential equation is $(1+ x^2)\frac{dy}{dx} + 2xy - 4x^2 = 0$ =>$\frac{dy}{dx} + \frac{2x}{1+x^2}y = \frac{4x^2}{1+x^2}$ Which is the equation of the form $\frac{dy}{dx}$ + Py = Q Where P = $\frac{2x}{1+x^2}$ and Q = $\frac{4x^2}{1+x^2}$ Now, IF = $e\int \frac{2x}{1} + x^2$ = $e^{\log(1+x^2)}$ = 1 + x^2 The general solution is Y(1+x^2) = $\int (1+x^2) \frac{4x^2}{(1+x^2)}$dx +C => (1+ x^2)y = $\int 4x^2$dx + C => (1+ x^2)y = $\frac{4x^3}{3}$ + C => y = $\frac{4x^3}{3(1+x^2)}$ + C$(1+x^2)^{-1}$ …(i) Now, y(0) = 0 => 0 = $\frac{4\cdot 0^3}{3(1+0^2)}$ + C$(1+0^2)^{-1}$ => C = 0 Put the value of C in Eq. (i), we get Y =$\frac{4x^3}{3(1+x^2)}$, which is the required solution.	3

CHAPTER-9

DIFFERENTIAL EQUATIONS

04 MARKS TYPE QUESTIONS

Q. NO	QUESTION	MARK
1.	rate of increase in the number of bacteria in a certain bacteria culture is proportional to the number present. Given that the number triples in 5 hours (i)The value $\int \frac{1}{kx} dx$ (a) $log\ x\| + c$ (b)$log\ log\ \|kx\| + c$ (c)$\frac{1}{k} log\ log\ \|x\| + c$ (d) none (ii) If ‘N’ is the number of bacteria, the corresponding differential equation is ____________. (a) $\frac{dN}{dt} = kt$ (b) $\frac{dN}{dt} = kN$ (c) $\frac{dk}{dt} = N$ (d) $\frac{dk}{dN} = t$ (iii) The general solution is (a) $log\ log\ \|N\| = kt + c$ (b) $log\ log\ Nt\ \| = k + c$ (c) $log\ log\ \|N\| = t$ (d) $log\ log\ \|kt\| = N + c$ (iv)The bacteria become 10 times in ______________ hours. (a) $5log7$ (b) $\frac{5log10}{log3}$ (c) $\frac{5}{log3}$ (d) none	4
2.	 It is known that, if the interest is compounded continuously, the principal changes at the rate equal to the produd’ of the rate of bank interest per annum and the principal. Let P denotes the principal at any time t and rate of interest be r % per annum Based on the above information, answer the following questions. (i) Find the value of $\frac{dp}{dt}$ (a)$\frac{pr}{1000}$ (b) $\frac{pr}{100}$ (c) $\frac{pr}{20}$ (d) $\frac{pr}{20}$ (ii). If P_0 be the initial principal, then find the solution of differential equation formed in given situation. (a)log $\frac{p}{p_0} = \frac{rt}{100}$ (b) $log\ log\ \left(\frac{p}{p_0}\right) = \frac{rt}{10}$ (c) $log\ log\ \left(\frac{p}{p_0}\right) = \frac{r}{20}$ $(d) none$ (iii)If the interest is compounded continuously at 5% per annum, in how many years will	4

	Rs.100 double itself? (a) 12.728 years (b) 14.789 years (c) 13.862 years (d) 15.872 years (iv)How much will Rs.1000 be worth at 5% interest after 10 years? (e0.5 = 1.648). (a) Rs.1648 (b) Rs 1500 (c) Rs 1664 (d) Rs 1572	
3.	 A rumour on whatsapp spreads in a population of 5000 people at a rate proportional to the product of the number of people who have heard it and the number of people who have not. Also, it is given that 100 people initiate the rumour and a total of 500 people know the rumour after 2 days. (i)If yet denote the number of people who know the rumour at an instant t, then maximum value of y(t) is (a) 500 (b) 100 (c) 5000 (d) none of these (ii) $\frac{dy}{dt}$ *is proprtional to* (a)(y – 5000) (b) y(y – 500) (c) y(500 – y) (d) y(5000 – y) (iii) The value of y(0) is (a)100 (b) 500 (c) 600 (d) 200 (iv) The value of y(2) is (a)100 (b) 500 (c) 600 (d) 200	4
4.	Polio drops are delivered to 50K children in a district. The rate at which polio drops are given is directly proportional to the number of children who have not been administered the drops. By the end of 2nd week half the children have been given the polio drops. How many will have been given the drops by the end of 3rd week can be estimated using the solution to the differential equation $dydx$ = K (50 – y) where x denotes the number of weeks and y the number of children who have been given the drops. 1. State the order of the above given differential equation. 2. Which method of solving a differential equation can be used to solve $dydx$ = k (50 – y) a) Variable separable method b) Solving Homogeneous differential equation c) Solving Linear differential equation d) All of the above 3. The solution of the differential equation $dydx$ = k (50 – y) is given by, a) log | 50 – y| = kx + C b) - log | 50 – y| = kx + C c) log | 50 – y| = log| kx |+ C d) 50 – y = kx + C 4. The value of c in the particular solution given that y(0)=0 and k = 0.049 is : a) log 50	**4**

	b) log 1 50 c) 50 d) -50 5. Which of the following solutions may be used to find the number of children who have been given the polio drops? a) y = 50 – ekx b) y = 50 − e $-kx$ c) y = 50 (1 – e $-k$) d) y = 50 (ekx– 1)	
5.	A Veterinary doctor was examining a sick cat brought by a pet lover. When it was brought to the hospital, it was already dead. The pet lover wanted to find its time of death. He took the temperature of the cat at 11.30 pm which was 94.6 ○F. He took the temperature again after one hour; the temperature was lower than the first observation. It was 93.4 ○F. The room in which the cat was put is always at 70 ○F. The normal temperature of the cat was 98.6 ○F when it was alive. The doctor estimated the time of death using Newton law of cooling which is governed by the differential equation:$dTdt$∝ (T − 70), where 70 ○F is the room temperature and T is the temperature of the object at time t. Substituting the two different observations of T and t made, in the solution of the differential equation $dTdt$ = k(T − 70) where k is a constant of proportion, time of death is calculated. 1) 1) State the degree of the above given differential equation. 2) 2) Which method of solving a differential equation helped in calculation of the time of death? **a)** Variable separable method b) Solving Homogeneous differential equation c) Solving Linear differential equation d) all of the above 3) If the temperature was measured 2 hours after 11.30pm, will the time of death change? (Yes/No) 4) The solution of the differential equation $dTdt$ = k(T − 70) is given by, a) log | T – 70| = kt + C b) log | T – 70| = log |kt |+ C c) T – 70 = kt + C d) T – 70 = kt C 5) If t = 0 when T is 72, then the value of c is a) -2 b) 0 c) 2 d) Log 2	4
6.	In a bank, principal increases continuously at the rate of 5% per year. In how many years Rs 1000 double itself?	4
7.	Solve the differential equation: (xdy-ydx)y $\sin\left(\frac{y}{x}\right)$=(ydx+xdy)x $\cos\left(\frac{y}{x}\right)$.	4
8.	Find a particular solution of the differential equation$\frac{dy}{dx} + 2y\ tanx = sinx\ ; y = 0\ when\ x = \frac{\pi}{3}$.	4
9.	In a bank, principal increases continuously at the rate of r% per year. Find the value of r if Rs 100 double itself in 10 years($\log_e 2$=0.6931).	4
10.	Find the particular solution of the differential equation $\frac{dy}{dx} = -\frac{x+y\cos x}{1+\sin x}$, given that $y = 1\ when\ x = 0$	4
11.	Solve the differential equation $xdy - ydx = \sqrt{x^2+y^2}dx$, given that $y = 0\ when\ x = 1$	4
12.	Find the particular solution of the differential equation	4

	$\frac{dy}{dx} = \frac{xy}{x^2+y^2}$, given that $y = 1$ when $x = 0$	
13.	In a bank, principal increases continuously at the rate of 5% per year. In how many years Rs 1000 double itself ?  	4
14.	A Veterinary doctor was examining a sick cat brought by a pet lover.When it was brought to the hospital, it was already dead.The pet lover wanted to find its time of death. He took the temperature of the cat at 11:30pm which wass 94.6∘ F. He took the temperature again after 1h; the temperature was lower than the first observation .It was 93.4∘ F. The room in which the cat was put is always at 70∘ F.The normal temperature of the cat is taken as 98.6∘ $F$when it was alive . The doctor estimated the time of time of death using Newton law of cooling which is governed by the differential equation :$\frac{dT}{dt} \propto (T - 70)$,*where 70*∘ $F$is the room temperature and Tis the temperature of object at time t. Substituting the two different observations of Tand t made, in the solution of the differential equation $\frac{dT}{dt}$ = k(T – 70), where k is a constant ofproportion, time of death is calculated. Answer the following questions using the above information. (i)The degree of the above given differential equation is (a)0 (b)1 (c)2 (d)3 (ii)If the temperature was measured 2h after 11:30pm, will time of death change? (a)Yes (b)No (c)Can't say (d)None of these (iii)The solution of the differential equation $\frac{dT}{dt}$= k(T- 70)is given by, (a)log|T-70| =kt + C (b)log|T-70| = log|kt| + C (c)T-70 = kt + C (d) t- 70 = kT + C (iv)If t =0 when T is 72, then the value of C is (a)-2 (b)0 (c)2 (d)log2	4
15.	Consider the differential equation $\frac{dy}{dx}$ + 2ytanx = sinx. Answer the following questions which are based on above information. (i)Find the values of Pand Q , if the given differential equation can be written in the form of $\frac{dy}{dx}$ +Py = Q. (ii)Find the integrating factor of the differential equation. (iii)Find the solution of the differential equation. (iv)If y$\left(\frac{\pi}{3}\right)$= 0,then write the relation between x and y.	4

ANSWERS:

Q. NO	ANSWER	MARKS
1.	i)(c) ii) (b). iii)(a). iv)(b)	
2.	i)(b)Here, P denotes the principal at any time t and the rate of interest be r% per annum compounded continuously, then according to the law given in the problem, we get $\frac{pr}{100}$ (ii) (a). (iii) (c). (iv) (d)	
3.	i)c)Since, size of population is 5000. Hence, Maximum value of y(t) is 5000. ii) (d) : Clearly, according to given information $$\frac{dy}{dt} = ky(5000 - y)$$,where k is the constant of proportionality. iii)(a) y(0)=100 iv)(b) y(2)=500	
4.	1) Degree is 1 2) (a) Variable separable method 3) No 4) (a) log | T –70| = kt + C 5) (d)log 2	
5.	1) Order is 1 2) (a) Variable separable method 3. (b)- log | 50– y| = kx + C 4. (b) log 1 50 5. (c) y = 50 ((1 – e^{-k})	
6.	Let P be the principal at any time t. According to the given problem, $\frac{dP}{dt}=\left(\frac{5}{100}\right)P$ $\frac{dP}{P}=\frac{dt}{20}$ Integrate it, we get General solution P=C$e^{\frac{t}{20}}$, Substituting P=1000 when t=0 we get c=1000 Let t years be the time required to double the principal. Then 2000 = 1000$e^{\frac{t}{20}}$ gives t=20$\log_e$2	4
7.	ANS:This is of the form $\frac{dy}{dx}$=g$\left(\frac{y}{x}\right)$. Put y=vx ,then $\frac{dy}{dx}$=v+x$\frac{dv}{dx}$ Gives $\left(\frac{vsinv-cosv}{vcosv}\right) dv$=2$\frac{dx}{x}$ Integrate it, we get $\frac{secv}{vx^2}$=c Put v=$\frac{y}{x}$,we get General solution sec$\left(\frac{y}{x}\right)$ =cxy	4
8.	y =$cosx - 2cos^2x$	4
9.	P=C$e^{\frac{rt}{100}}$,r=6.931%	4

10.	$\frac{dy}{dx} = -\left[\frac{x + y\cos x}{1 + \sin x}\right]$ $\Rightarrow \frac{dy}{dx} + \frac{\cos x\, y}{1 + \sin x} = \frac{-x}{1 + \sin x} \ldots (i)$ $\frac{dy}{dx} + Py = Q \ldots (ii)$ On comparison, we get $P = \frac{\cos x}{1 + \sin x}, Q = \frac{-x}{1 + \sin x}$ Integrating Factor (I. F) $= e^{\int p dx} = e^{\int \frac{\cos x}{1+\sin x}} = e^{\log\|1+\sin x\|} = 1 + \sin x$ Hence, the sol^{n} is : $y \times \text{I.F} = \int Q \times \text{I.F}\, dx$ $\Rightarrow y(1 + \sin x) = \int \frac{-x}{(1 + \sin x)}.(1 + \sin x)dx$ $\Rightarrow y(1 + \sin x) = -\int x\, dx$ $\Rightarrow y(1 + \sin x) = -\frac{x^2}{2} + c$ It is given that $y = 1$ when $x = 0$ $\therefore 1 = 0 + c$ $\Rightarrow c = 1$ Hence, the complete sol^{n} is : $y(1 + \sin x) = -\frac{x^2}{2} + 1$	4
11.	$xdy - ydx = \sqrt{x^2 + y^2}dx$ $\Rightarrow xdy = \left(y + \sqrt{x^2 + y^2}\right)dx$ $\Rightarrow \frac{dy}{dx} = \frac{y + \sqrt{x^2 + y^2}}{x} \ldots (i)$ Let, $f(x, y) = \frac{y + \sqrt{x^2 + y^2}}{x}$ $\therefore\ f(\lambda x, \lambda y) = \frac{\lambda y + \sqrt{\lambda^2 x^2 + \lambda^2 y^2}}{\lambda x} = \frac{y + \sqrt{x^2 + y^2}}{x} = f(x, y)$ Hence, f is a homogeneous function of degree 0. Let, $y = vx$ Differentiating both sides w. r. t. x $\frac{dy}{dx} = v + x\frac{dv}{dx}$ Hence, eq^{n}(i) becomes $v + x\frac{dv}{dx} = \frac{vx + \sqrt{x^2 + v^2x^2}}{x}$ $\Rightarrow v + x\frac{dv}{dx} = v + \sqrt{1 + v^2}$ $\Rightarrow x\frac{dv}{dx} = \sqrt{1 + v^2}$ $\Rightarrow \frac{dv}{\sqrt{1 + v^2}} = \frac{dx}{x}$ $\Rightarrow \int \frac{dv}{\sqrt{1 + v^2}} = \int \frac{dx}{x}$ $\Rightarrow \log\left\|v + \sqrt{1 + v^2}\right\| = \log\|x\| + c$	4

	$\Rightarrow \log\left\|\frac{y}{x}+\sqrt{1+\frac{y^2}{x^2}}\right\| = \log\|x\| + c$ It is given that $y = 0$ when $x = 1$ $\therefore 0 = 0 + c$ $\Rightarrow c = 0$ Hence, the complete sol^{n} is : $\log\left\|\frac{y}{x}+\sqrt{1+\frac{y^2}{x^2}}\right\| = \log\|x\|$	
12.	Given differential equation can be rewritten as $\frac{dx}{dy} = \frac{x^2+y^2}{xy} = \frac{x}{y}+\frac{y}{x} = \left(\frac{x}{y}\right)+\left(\frac{1}{\frac{x}{y}}\right) = f\left(\frac{x}{y}\right) ------ (i)$ Which is a homogeneous differential equation Now. Let $\frac{x}{y} = v \Rightarrow x = vy$ On differentiating wrt y on both sides, we get $\frac{dx}{dy} = v + y\frac{dv}{dy} ------(ii)$ using (ii) in (i), we get $v + y\frac{dv}{dy} = v + \frac{1}{v}$ $\int v\, dv = \int \frac{dy}{y}$ $\frac{v^2}{2} = \log y + C$ $\frac{x^2}{2y^2} = \log y + C$ y=1, when x=0 so we get C=0 Hence, particular solution of the given differential equation is $\frac{x^2}{2y^2} = \log y \Rightarrow x^2 = 2y^2 \log y$	4
13.	Let P be the principal at any time t. So, $\frac{dp}{dt} = \left(\frac{5}{100}\right)P \Rightarrow \frac{dp}{dt} = \frac{P}{20}$----------------------(i) Separating the variables $\frac{dp}{P} = \frac{dt}{20}$------------------(ii) Integrating both sides $\log P = \frac{t}{20} + C_1$ $P = e^{\frac{t}{20}}.e^{C_1}$	4

$$P = C\, e^{\frac{t}{20}}$$

Now P=1000, when t=0, we get

$$P = 1000\, e^{\frac{t}{20}}$$

Let t years be the time required to double the Principal. Then

$$2000 = 1000\, e^{\frac{t}{20}}$$

$\Rightarrow \quad t = 20log_e 2$

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14. (Marks: 4)

Given, differential equation can be rewritten as

F(x,y) = $\frac{dy}{dx} = \frac{y}{2x - x\log(\frac{y}{x})}$

Verify F(λx, λy) = F(x,y)

On putting y = vx and $\frac{dy}{dx}$ = v + x$\frac{dv}{dx}$, then given equation

Becomes

=> v + x$\frac{\mathrm{dv}}{\mathrm{dx}} = \frac{vx}{2x - xlog(\frac{vx}{x})}$

=> x $\frac{dv}{dx} = \frac{v}{2-logv}$ - v

=>$\int 2 - logv/v(logv-1)$dv = $\int dx/x$

On putting log v = t and $\frac{1}{v}$dv = dt, we get

$\int 2 - t$/t-1dt = log|x| + C

=>$\int(\frac{1}{\mathrm{t-1}}$- - 1)dt = log|x| + C

=> log(t-1) – t = log|x| + C

=> log[log4)-1] – log4 = log|x| + C

=> log[(log$\frac{y}{x}$) -1] -log($\frac{y}{x}$) = logx + C

=> log[(log$\frac{y}{x}$) – 1] -logy = C

∴ log|$\frac{\frac{logy}{x} - 1}{y}$| = C

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15. (Marks: 4)

(i) Given , differential equation is

$\frac{\mathrm{dy}}{\mathrm{dx}}$ + 2ytanx = sinx

Which is a linear differential equation of the form

$\frac{\mathrm{dy}}{\mathrm{dx}}$ + Py = Q.

Here,P = 2tanx and Q = sinx

(ii) IF =$e^{\int Pdx} = e^{\int 2tanx\, dx}$

=$e^{\int tanx\, dx}$ = $e^{2\log|\sec x|}$

= e^{logsec^2x} = $\sec^2$ x [∵$e^{\log(x)}$ = f(x)]

(iii) The solution of differential equation is given by

y·$\sec^2$ x = $\int sec^2$x·sinxdx + C

=> y·$\sec^2$ x = $\int sinx/\cos{}^\wedge 2x\, dx$·sinxdx + C

Put cosx = t , then -sinxdx =dt

∴ y·$\sec^2$x = -$\int dt/t{}^\wedge 2$ + C

=> y·$\sec^2$x = -$\int t^{-2}$dt + C

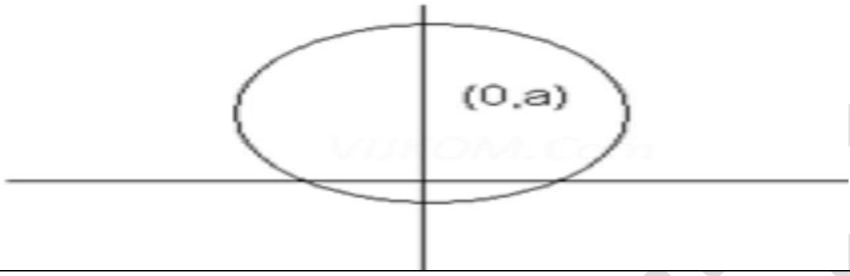
=> y·$\sec^2$x = -1$\frac{t-{}^\wedge 1}{(-1)}$ + C

	$y \cdot \sec^2 x = \frac{1}{t} + C$ $y \cdot \sec^2 x = \frac{1}{cosx} + C$ $y \cdot \sec^2 x = \sec x + C$ => $y = \frac{1}{\sec x} + \frac{C}{\sec \hat{} 2x}$ [dividing each term by $\sec^2 x$] => $y = \cos x + C \cdot \cos^2 x$ (iv) It given that y = 0, when $x = \frac{\pi}{3}$ ∴ $0 = \cos\frac{\pi}{3} + C \cdot \cos^2\frac{\pi}{3}$ => $0 = \frac{1}{2} + C \cdot \frac{1}{4}$ [∵ $\cos\frac{\pi}{3} = \frac{1}{2}$] => $\frac{-1}{2} = \frac{C}{4}$ => C = -2 ∴ The required particular solution is => $y = \cos x - 2\cos^2 x$	

CHAPTER-9

DIFFERENTIAL EQUATIONS

05 MARK TYPE QUESTIONS

Q. NO	QUESTION	MARK
1.	Form the differential equation of the family of circles having centre on y-axis and radius 3 units. 	5
2.	Solve $(x^2 - y^2)dx + 2xydy = 0$	5
3.	$\frac{dy}{dx} + \frac{y}{x} = 0$ where 'x' denotes the percentage population in a city and 'y' denotes the area for living healthy life of population. Find the particular solution when x=100,y=1. Is higher density of population harmful? Justify your answer	5
4.	Solve the differential equation (xdy-ydx)y sin(y/x) = (ydx+xdy)x cos(y/x).	**5**
5.	Find the equation of a curve passing through (0,$\frac{\pi}{4}$)and satisfying the differential equation Sinx.cosy dx + cosx.siny dy=0	**5**
6.	Find the particular solution of the differential equation $\frac{dy}{dx}$ +ycotx =2x+x^2cotx (x≠0) given that y=0 when x=$\frac{\pi}{2}$.	5
7.	Show that the differential equation $2ye^{\frac{x}{y}}dx+\left(y - 2xe^{\frac{x}{y}}\right)dy=0$ is homogeneous and find its particular solution, given that, x= 0 when y = 1	5
8.	In a lab, if in a culture, the bacteria count is 1,00,000.The number is increased by 10 % in 2 hours. In how many hours will the count reach 2, 00, 000, if the rate of growth of bacteria is proportional to the number present?	5
9.	The population of a village increase continuously at the rate proportional to the number of its inhabitants present at any time .If the population of the village was 20000 in 2018 and 25000 in the year 2023, what will be the population of the village in 2028?	5
10.	Find the particular solution of the differential equation $x\frac{dy}{dx}sin\left(\frac{y}{x}\right) + x - ysin\left(\frac{y}{x}\right) = 0$, given that $y(1) = \frac{\pi}{2}$.	5
11.	$(x^2 + y^2)dy = xydx$. If $y(1) = 1$ and $y(x_0) = e$, then find the value of x_0.	5
12.	Find the general solution of the differential equation $ydx - (x + 2y^2)dy = 0$	5
13.	Find the particular solution of the differential equation, satisfying the given condition $(x + y)dy + (x - y)dx = 0\ ; y = 1\ when\ x = 1$	5
14.	Find the particular solution of the differential equation $x\frac{dy}{dx}$= y -xtan($\frac{y}{x}$), given that y = π/4 at x =1.	5
15.	Solve the differential equation	5

	$xdy - ydx = \sqrt{x^2 + y^2}\, dx$, Given that y =0, when x=1.	

ANSWERS:

Q. NO	ANSWER	MARKS
1.	As the centre of the circle lies on the y-axis. Let the center be (0,k). Thus the equation of the circles with center (0,k) and radius 3 is, $$(x-0)^2 + (y-k)^2 = 3^2$$ Differentiating and by solving we get $$(x^2-9)y^2 + x^2 = 0$$ Which is required solution.	
2.	$$x^2 - y^2 = Cx$$	
3.	$$\frac{dy}{dx} + \frac{y}{x} = 0$$ $$\frac{dy}{dx} = -\left(\frac{y}{x}\right)$$ Differentiating and by solving we get xy=100	
4.	sec(y/x) = cxy	
5.	cosy = secx/$\sqrt{2}$	
6.	The given equ. is a L.D.E. of the type $\frac{dy}{dx}$+Py=Q ,where P=cotx and Q=2x+x^2cotx. IF= $e^{\int cotx dx}$= sinx, General solution is given by ysinx=$\int(2x + x^2 cotx) sinx dx + c$ Gives ysinx=x^2sinx+c, Substituting y=0 and x=$\frac{\pi}{2}$ we get c=$\frac{-\pi^2}{4}$ Particular solution y=x^2 - $\frac{\pi^2}{4sinx}$	5
7.	This is of the form $\frac{dx}{dy}$=g$\left(\frac{x}{y}\right)$. Put x=vy ,then $\frac{dx}{dy}$=v+y$\frac{dv}{dy}$ Gives 2e^vdv=$\frac{-dy}{y}$ Integrate it, we get 2e^v= - log|y|+c Put v=$\frac{x}{y}$,we get General solution 2$e^{\frac{x}{y}}$+log|y|=c, Substituting x=0 and y=1 we get c=2 Particular solution 2$e^{\frac{x}{y}}$+log|y|=2.	5
8.	t =$\frac{2\log 2}{log\frac{11}{10}}$	5
9.	31250	5
10.	$$x\frac{dy}{dx}\sin\left(\frac{y}{x}\right) + x - y\sin\left(\frac{y}{x}\right) = 0$$ $$\Rightarrow \frac{dy}{dx} = \frac{y\sin\left(\frac{y}{x}\right) - x}{x\sin\left(\frac{y}{x}\right)} \ldots (i)$$	5

Let, $f(x,y) = \dfrac{y\sin\left(\frac{y}{x}\right) - x}{x\sin\left(\frac{y}{x}\right)}$

$$\therefore\ f(\lambda x,\lambda y) = \frac{\lambda y\sin\left(\frac{\lambda y}{\lambda x}\right) - \lambda x}{\lambda x\sin\left(\frac{\lambda y}{\lambda x}\right)} = \frac{y\sin\left(\frac{y}{x}\right) - x}{x\sin\left(\frac{y}{x}\right)} = f(x,y)$$

Hence, f is a homogeneous function of degree 0.

Let, $y = vx$

Differentiating both sides w. r. t. x

$$\frac{dy}{dx} = v + x\frac{dv}{dx}$$

Hence, eq^n(i) becomes

$$v + x\frac{dv}{dx} = \frac{vx\sin v - x}{x\sin v}$$

$$\Rightarrow vx\frac{dv}{dx} = \frac{vx\sin v - x}{x\sin v} - v$$

$$\Rightarrow x\frac{dv}{dx} = \frac{vx\sin v - x - vx\sin v}{x\sin v}$$

$$\Rightarrow x\frac{dv}{dx} = \frac{-x}{x\sin v}$$

$$\Rightarrow x\frac{dv}{dx} = -\frac{1}{\sin v}$$

$$\Rightarrow \sin v\, dv = -\frac{dx}{x}$$

$$\Rightarrow \int \sin v\, dv = -\int \frac{dx}{x}$$

$$\Rightarrow -\cos v = -\log|x| + c$$

$$\Rightarrow -\cos\left(\frac{y}{x}\right) = -\log|x| + c$$

It is given that $y = \frac{\pi}{2}$ when $x = 1$

$$\therefore -\cos\frac{\pi}{2} = -\log 1 + c$$

$$\Rightarrow -0 = -0 + c$$

$$\Rightarrow c = 0$$

Hence, the complete sol^n is :

$$-\cos\left(\frac{y}{x}\right) = -\log|x|$$

$$\Rightarrow \cos\left(\frac{y}{x}\right) = \log|x|$$

11. (5 marks)

$$(x^2 + y^2)dy = xydx$$

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

Let, $f(x,y) = \dfrac{xy}{x^2 + y^2}$

$$\therefore\ f(\lambda x,\lambda y) = \frac{\lambda x.\lambda y}{\lambda^2 x^2 + \lambda^2 y^2} = \frac{xy}{x^2 + y^2} = f(x,y)$$

Hence, f is a homogeneous function of degree 0.

Let, $y = vx$

Differentiating both sides w. r. t. x

$$\frac{dy}{dx} = v + x\frac{dv}{dx}$$

	Hence, eq^{n}(i) becomes $v + x\frac{dv}{dx} = \frac{x.vx}{x^2 + v^2x^2}$ $\Rightarrow v + x\frac{dv}{dx} = \frac{v}{1+v^2}$ $\Rightarrow x\frac{dv}{dx} = \frac{v}{1+v^2} - v$ $\Rightarrow x\frac{dv}{dx} = \frac{v - v(1+v^2)}{1+v^2}$ $\Rightarrow x\frac{dv}{dx} = \frac{v - v - v^3}{1+v^2}$ $\Rightarrow x\frac{dv}{dx} = \frac{-v^3}{1+v^2}$ $\Rightarrow \frac{(1+v^2)dv}{v^3} = -\frac{dx}{x}$ $\Rightarrow \int \left[\frac{1}{v^3} + \frac{1}{v}\right] dv = -\int \frac{dx}{x}$ $\Rightarrow -\frac{1}{2v^2} + \log\lvert v\rvert = -\log\lvert x\rvert + c$ $\Rightarrow -\frac{x^2}{2y^2} + \log\left\lvert\frac{y}{x}\right\rvert = -\log\lvert x\rvert + c$ It is given that $y = 1$ when $x = 1$ $\therefore -\frac{1}{2} + 0 = 0 + c$ $\Rightarrow c = -\frac{1}{2}$ Hence, the complete sol^{n} is : $-\frac{x^2}{2y^2} + \log\left\lvert\frac{y}{x}\right\rvert = -\log\lvert x\rvert - \frac{1}{2}$ Now, $x = x_0$ and $y = e$, then $-\frac{{x_0}^2}{2e^2} + \log\left\lvert\frac{e}{x_0}\right\rvert = -\log\lvert x_0\rvert - \frac{1}{2}$ $\Rightarrow -\frac{{x_0}^2}{2e^2} + \log\left\lvert\frac{e}{x_0}\right\rvert + \log\lvert x_0\rvert + \frac{1}{2} = 0$ $\Rightarrow -\frac{{x_0}^2}{2e^2} + \log\left\lvert\frac{e}{x_0}.x_0\right\rvert + \frac{1}{2} = 0$ $\Rightarrow -\frac{{x_0}^2}{2e^2} + \log\lvert e\rvert + \frac{1}{2} = 0$ $\Rightarrow -\frac{{x_0}^2}{2e^2} + 1 + \frac{1}{2} = 0$ $\Rightarrow -\frac{{x_0}^2}{2e^2} = -\frac{3}{2}$ $\Rightarrow {x_0}^2 = 3e^2$ $\Rightarrow x_0 = \pm\sqrt{3}e$	
12.	The given differential equation can be rewritten as $\frac{dx}{dy} - \frac{x}{y} = 2y$ Which is a linear differential equation of the type $\frac{dx}{dy} + Px = Q, where\ P = \frac{-1}{y}\ \ and\ Q = 2y$	5

	Therefore, I.F.=$e^{\int \frac{-1}{y} dy} = e^{-\log y} = \frac{1}{y}$ Hence, the solution of the given differential equation is $x\frac{1}{y} = \int (2y)\left(\frac{1}{y}\right) dy + C$ $\frac{x}{y} = 2y + C$ $x = 2y^2 + Cy$ Which is a general solution of the given differential equation.	
13.	The given differential equation can be rewritten as $\frac{dy}{dx} = \frac{y-x}{y+x} = \frac{\frac{y}{x}-1}{\frac{y}{x}+1} = f\left(\frac{y}{x}\right)$ Which is a homogeneous differential equation Now. Let $\frac{y}{x} = v \Rightarrow y = vx$ On differentiating wrt x on both sides, we get $\frac{dy}{dx} = v + x\frac{dv}{dx} ------(ii)$ Putting (ii) in (i), we get $v + x\frac{dv}{dx} = \frac{v-1}{v+1}$ $x\frac{dv}{dx} = \frac{v-1}{v+1} - v = \frac{v-1-v^2-v}{v+1}$ $\int \frac{v+1}{v^2+1}\, dv = -\int \frac{dx}{x}$ $\frac{1}{2}\int \frac{2v}{v^2+1}\, dv + \int \frac{dv}{v^2+1} = -\int \frac{dx}{x}$ $\frac{1}{2}log(v^2+1) + tan^{-1}v = -\log x + C_1$ $log\left(\frac{y^2}{x^2}+1\right) + 2\, tan^{-1}\frac{y}{x} = -2\log x + 2C_1$ $\log(x^2+y^2) + 2\, tan^{-1}\frac{y}{x} = C$ y=1, when x=1 so we get C=$\log 2 + \frac{\pi}{2}$ Hence, particular solution of the given differential equation is $\log(x^2+y^2) + 2\, tan^{-1}\frac{y}{x} = \log 2 + \frac{\pi}{2}$	5
14.	. :·Particular solution is given by x·sin($\frac{y}{x}$) = $\frac{1}{\sqrt{2}}$	5
15.	. y + $\sqrt{x^2+y^2} = x^2$ which is the required solution	5

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