# MATHS

## BOOKS - ML KHANNA

## DIFFERENTIAL EQUATIONS

### Problem Set 1 Multiple Choice Questions

**1.** A differential equation of the family of curves $y = a\sin px + b\cos px$ where a, b are arbitrary constants, is given by

A. $\frac{d^2y}{dx^2} + py = 0$

B. $\frac{d^2y}{dx^2} + p^2y = 0$

C. $\frac{d^2y}{dx^2} - p^2y = 0$

D. $\frac{d^2y}{dx^2} - py = 0$

**Answer: B**

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**2.** If m be the order and n the degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^2 + x\left(\frac{dy}{dx}\right)^2 = 0$ then (m, n) =

A. (2, 2)

B. (3, 3)

C. (2, 3)

D. none

**Answer: A**

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**3.** The order and degree of the differential equation $\frac{d^4y}{dx^4} = y + \left(\frac{dy}{dx}\right)^4$ are

A. 2, 4

B. 4, 1

C. 4, 2

D. 2, 2

**Answer: B**

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**4.** The degree and order of the differential equation of the family of all parabolas whose axis is x-axs are respectively

A. 2, 1

B. 1, 2

C. 3, 2

D. 2, 3

**Answer: B**

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**5.** The differential equation whose solution is $Ax^2 + By^2 = 1$ , where $A$ and $B$ are arbitrary constants, is of (a) second order and second degree (b) first order and second degree (c) first order and first degree (d) second order and first degree

A. 1st order, 2nd degree

B. 1st order, 1st degree

C. 2nd order and 1st degree

D. 2nd order and 2nd degree

**Answer: D**

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**6.** The differential equation of the family of curves $y = e^x(A\cos x + B\sin x),$ where $A$ and $B$ are arbitrary constants is (a) $(b)(c)(d)\frac{(e)(f)d^{(g)2(h)}(i)y}{j}\Big((k)d(l)x^{(m)2(n)}(o)\Big)(p)(q) - 2(r)\frac{(s)dy}{t}((u)$

(y) (z) [Math Processing Error] (xx) (yy) [Math Processing Error] (eeee) (ffff)

[Math Processing Error] (ddddd)

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

B. $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} - 2y = 0$

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

D. $\frac{d^2y}{dx^2} - 7\frac{dy}{dx} + 2y = 0$

**Answer: A**

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**7.** Differential equation of the family of curves $v = \frac{A}{r} + B$, where $A$ and $B$ are arbitrary constants, is (a) $(b)(c)(d)\frac{(e)(f)d^{(g)2(h)}(i)v}{j}\Big((k)d(l)r^{(m)2(n)}(o)\Big)(p)(q) + (r)\frac{1}{s}r(t)(u)(v$

(cc) (b) $(dd)(ee)(ff)\frac{(gg)(hh)d^{(ii)2(jj)}(kk)v}{ll}\Big((mm)d(\cap)r^{(oo)2(pp)}(qq)\Big)(rr)(ss$

(eee) (c) [Math Processing Error] (ee) (d) None of these

A. $\frac{d^2v}{dr^2} + \frac{1}{r} \cdot \frac{dv}{dr} = 0$

B. $\frac{d^2v}{dr^2} - \frac{2}{r} \cdot \frac{dv}{dr} = 0$

C. $\frac{d^2v}{dr^2} + \frac{2}{r}\frac{dv}{dr} = 0$

D. None of these

**Answer: C**

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**8.** The differential equation of all circles which passes through the origin and whose centers lie on Y-axis is

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

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

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

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

**Answer: A**

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**9.** The differential equation of the family of circles passing through the origin and having centres on the x-axis is :

A. $x^2 - y^2 + xy\frac{dy}{dx}$

B. $x^2 = y^2 + 3xy\frac{dy}{dx}$

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

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

**Answer: C**

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**10.** The differential equation of the family of circles with fixed radius 5 units and centre on the line

$y = 2$ is $(y-2)^2\left\{1+\left(\frac{dy}{dx}\right)^2\right\} = 25$

True or False?

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**11.** The differential equation of the family of curves $y = Ae^{3x} + Be^{5x}$, where A, B are arbitrary constants, is

A. $\frac{d^2y}{dx^2} + 8\frac{dy}{dx} + 15y = 0$

B. $\frac{d^2y}{dx^2} - 8\frac{dy}{dx} + 15y = 0$

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

D. None of these

**Answer: B**

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**12.** The equation of the curve passing through (3, 9) which satisfies $dy/dx = x + 1/x^2$ is :

A. $6xy = 3x^2 - 6x + 29$

B. $6xy = 3x^2 - 29x + 6$

C. $6xy = 3x^3 + 29x + 6$

D. None of these

**Answer: C**

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**13.** The equation of the curve through the point (1,0) whose slope is $\frac{y-1}{x^2+x}$ is:

A. $(y-1)(x+1) + 2x = 0$

B. $2x(y-1) + x + 1 = 0$

C. $x(y-1)(x+1) + 2 = 0$

D. $x(y+1)+y(x+1)=0$

**Answer: A**

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**14.** Equation of curve passing through (1, 1) and satisfying the differential equation $\frac{dy}{dx}=\frac{2y}{x}$,

( where $x>0, y>0$) is given by :

A. $x^2=y$

B. $x=y^2$

C. $x=2y$

D. $y=2x$

**Answer: A**

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**15.** The differential equation which represents the family of curves $y = e^{cx}$ is :

A. $y' = cy$

B. $xy' - \log y = 0$

C. $x \log y = yy'$

D. $y \log y = xy'$

**Answer: A**

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**16.** A curve passes through (1, 1) and any tangent at a point P on the curve is such that it intersects x and y axes at A and B respectively. If PA:PB=3:1, then differential equation of the curve is :

A. $xy' - 3y = 0$

B. $xy' + x^2 = 0$

C. $xy' + 3y = 0$

D. Curve passes through $\left(\frac{1}{8}, 2\right)$

**Answer: C::D**

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**17.** If $(1-y)x\frac{dy}{dx} + (1+x)y = 0$ then solution of above equation is

A. $\log xy + x + y = c$

B. $\log xy + x - y = c$

C. $\log xy - x - y = c$

D. None of these

**Answer: B**

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**18.** The differential equation $\frac{dy}{dx} = \frac{\sqrt{1-y^2}}{y}$ determines a fimily of circular with

A. variable radii and a fixed centre at (0,1)

B. variable radii and a fixed centre at (0, -1)

C. fixed radius 1 and variable centres along the x-axis

D. fixed radius 1 and variable centres along the y-axis

**Answer: C**

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**19.** If $y = y(x)$ and $\frac{2+\sin x}{y+1}\left(\frac{dy}{dx}\right) = -\cos x, y(0) = 1$, then $y(\pi/2)$ equals

A. $1/3$

B. $2/3$

C. $-1/3$

D. 1

**Answer: A**

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**20.** The solution of the equation

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

A. $\frac{1}{x} + y + \log y = c$

B. $\frac{1}{x} + y + \frac{1}{y^2} = c$

C. $\frac{1}{x} + \frac{1}{y} + \log y - x = c$

D. None of these

**Answer: C**

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**21.** The solution of the equation $\frac{dy}{dx} = \frac{x(2\log x + 1)}{\sin y + y\cos y}$ is

A. $y\sin y = x^2 \log x + \frac{x^2}{2} + c$

B. $y\cos y = x^2(\log + 1) + c$

C. $y\cos y = x^2 \log x + \frac{x^2}{2} + c$

D. $y\sin y = x^2 \log x + c$

**Answer: D**

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**22.** Solution of differential equation

$\frac{dy}{dx} = \sin(x + y) + \cos(x + y)$ is equal to

A. $\log\left(2 + \sec\frac{x + y}{2}\right) = x + c$

B. $\log\{1 + \tan(x + y)\} = y + c$

C. $\log\left\{1 + \tan\frac{x + y}{2}\right\} = y + c$

D. $\log\left\{1 + \tan\frac{x + y}{2}\right\} = x + c$

**Answer: D**

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**23.** The solution of the equation $\log\left(\frac{dy}{dx}\right) = ax + by$ is

A. $\frac{e^{by}}{b} = \frac{e^{ax}}{a} + c$

B. $\frac{e^{-by}}{-b} = \frac{e^{ax}}{a} + c$

C. $\frac{e^{-by}}{a} = \frac{e^{ax}}{b} + c$

D. None of these

**Answer: B**

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**24.** For the following question, choose the correct answer from the codes (a),(b),( c ) and (d) follows

Let a solution y=y(x) of the differential equation

$x\sqrt{x^2-1}dy - y\sqrt{y^2-1}dx = 0$ satisfy y(2)=$\frac{2}{\sqrt{3}}$

Statement I y(x) = sec $\left(\sec^{-1}x - \frac{\pi}{6}\right)$ and

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

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**25.** The solution the differential equation $\left(\frac{dy}{dx}\right)^2 - \left(\frac{dy}{dx}\right)(e^x + e^{-x}) + 1 = 0$ is

A. $y + e^{-x} = c$

B. $y - e^{-x} = c$

C. $y + e^{x} = c$

D. $y - e^{x} = c$

**Answer: A::D**

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**26.** The solution of the equation $\frac{dy}{dx} = \frac{y^2 - y - 2}{x^2 + 2x - 3}$ is

A. $\frac{1}{3}\log\left|\frac{y-2}{y+1}\right| = \frac{1}{4}\log\left|\frac{x-1}{x+3}\right| + c$

B. $\frac{1}{3}\log\left|\frac{y+1}{y-2}\right| = \frac{1}{4}\log\left|\frac{x+3}{x-1}\right| + c$

C. $\frac{1}{4}\log\left|\frac{y+1}{y-2}\right| = \frac{1}{3}\log\left|\frac{x+3}{x-1}\right| + c$

D. None of these

**Answer: A**

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**27.** Solution of the diff. equation

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

A. $y + 2x = x^2y/c^2$

B. $y - 2x = c^2x^2/y$

C. $y + 2x = c^2x^2/y$

D. None of these

**Answer: A**

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**28.** Solution of the differential equation $xdy - ydx = \sqrt{(x^2 + y^2)}dx$ is

A. $\left[y + \sqrt{(x^2 + y^2)}\right] = ky^2$

B. $\left[y + \sqrt{(x^2 + y^2)}\right] = kx^2$

C. $\left[y + \sqrt{(x^2 + y^2)}\right] = k(x^2 + y^2)$

D. None of these

**Answer: B**

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**29.** The solution of the equation

$(x^2 + xy)dy = (x^2 + y^2)dx$ is

A. $\log x = \log(x - y) + \frac{y}{x} + c$

B. $\log x = 2\log(x - y) + \frac{y}{x} + c$

C. $\log x = \log(x - y) + \frac{x}{y} + c$

D. None of these

**Answer: B**

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**30.** The solution of the equation $x\frac{dy}{dx} = y + x\tan\frac{y}{x}$ is

A. $\sin\frac{x}{y} = cx$

B. $\sin\frac{y}{x} = cx$

C. $\sin\frac{x}{y} = cy$

D. $\sin\frac{y}{x} = cy$

**Answer: B**

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**31.** The solution of the equation

$(x^2 - xy)dy = (xy + y^2)dx$ is

A. $xy = ce^{-y/x}$

B. $xy = ce^{-x/y}$

C. $yx^2 = ce^{1/x}$

D. None of these

**Answer: B**

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**32.** If $x\frac{dy}{dx} = y(\log y - \log x + 1)$, then the solution of the equation is

A. $\log\frac{x}{y} = cy$

B. $\log\frac{y}{x} = cy$

C. $\log\frac{x}{y} = cx$

D. $\log\frac{y}{x} = cx$

**Answer: D**

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**33.** The solution of the equation $x^2\frac{dy}{dx} = x^2 + xy + y^2$ is

A. $\tan^{-1}\left(\frac{y}{x}\right) = \log x + c$

B. $\tan^{-1}\left(\frac{x}{y}\right) = \log x + c$

C. $\tan^{-1}\left(\frac{x}{y}\right) = \log y + c$

D. $\tan^{-1}\left(\frac{y}{x}\right) = \log y + c$

**Answer: A**

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**34.** Solution of the diff. equation $\frac{dy}{dx} + \frac{3x + 2y - 5}{2x + 3y - 5} = 0$ is

A. $3x^2 + 4xy + 3y^2 - 10x - 10y = k$

B. $x^2 + 4xy - y^2 - 4x + 6y = k$

C. $(x + 2y)^2 + 3y = k$

D. None of these

**Answer: A**

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**35.** Solution of the diff. equation

$(6x + 2y - 10)(dy/dx) - 2x - 9y + 20 = 0$ is

A. $(y+2x)^2 = c(x-2y+5)$

B. $(y+2x)^3 = c(x+2y-5)$

C. $(y-2x)^2 = c(x+2y-5)$

D. None

**Answer: C**

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**36.** Solution of the diff. equation $\sin\left(\frac{dy}{dx}\right) = a$ when y(0) = 1

A. $\sin^{-1}\left[\frac{y-1}{x}\right] = a$

B. $\sin\left[\frac{y-1}{x}\right] = a$

C. $\sin \cdot \left(\frac{1-y}{1+x}\right) = a$

D. $\sin\left(\frac{y}{x+1}\right) = a$

**Answer: B**

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**37.** Solution of the differential equation

$(x+y)(dx-dy)=dx+dy$ is

A. $x+y=ke^{x+y}$

B. $x-y=ke^{x-y}$

C. $x+y=ke^{x-y}$

D. $x-y=ke^{x+y}$

**Answer: C**

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**38.** The solution of the differential equation

$\frac{dy}{dx}=\frac{\sin y+x}{\sin 2y-x\cos y}$ is

A. $\sin^2 y=x\sin y+\frac{x^2}{2}+c$

B. $\sin^2 y=x\sin y-\frac{x^2}{2}+c$

C. $\sin^2 y = x + \sin y + \frac{x^2}{2} + c$

D. $\sin^2 y = x - \sin y + \frac{x^2}{2} + c$

**Answer: A**

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**39.** The differential equation of all parabolas having their axis of symmetry coinciding with the axis of x is

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

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

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

D. none of these

**Answer: A**

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**40.** A particle moves in a straight line with a velocity given by $\frac{dx}{dt} = x + 1$ (x is the distance described).

The time taken by the particle to traverse a distance of 99 metres is

A. $\log_{10} e$

B. $2\log_e 10$

C. $2\log_{10} e$

D. $\frac{1}{2}\log_{10} e$

**Answer: B**

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**41.** The solution of the differential equation $\left(\frac{dy}{dx}\right)^2 - x\left(\frac{dy}{dx}\right) + y = 0$ is

A. y = 2

B. y = 2x

C. $y = 2x - 4$

D. $y = 2x^2 - 4$

**Answer: C**

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**42.** The differential equation representing the family of curves $y^2 = 2c(x + \sqrt{c})$ ,where c is a positive parameter is of

A. order 1

B. order 2

C. degree 3

D. degree 4

**Answer: A::C**

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**43.** The differential equation of the curve for which the initial ordinate of any tangent is equal to the corresponding subnormal (a) is linear (b) is homogeneous of second degree (c) has separable variables (d) is of second order

A. a linear equation

B. a homogeneous equation

C. an equation with separable-variables

D. none of these

**Answer: A::B**

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**44.** The solution of differential equation $xy' = x\left(\frac{y^2}{x^2} + \frac{f\left(\frac{y^2}{x^2}\right)}{f'\left(\frac{y^2}{x^2}\right)}\right)$ is

(a)

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

(z) (b) *[Math Processing Error]* (ggg) (c)

$(d)(e)(f)x^{(g)2(h)}(i)f\left((j)(k)(l)\frac{(m)(n)y^{(o)2(p)}(q)}{r}\left((s)(t)x^{(u)2(v)}(w)\right)\right.$

(bb) (d) *[Math Processing Error]* (bbb)

A. $f\left(y^2/x^2\right)=cx^2$

B. $x^2f\left(y^2/x^2\right)=c^2y^2$

C. $x^2f\left(y^2/x^2\right)=c$

D. $f\left(y^2/x^2\right)=cy/x$

**Answer: A**

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**45.** Solution of the differential equation $y_3-8y_2=0$ where $y(0)=\frac{1}{8}, y_1(0)=0, y_2(0)=1$ is equal to

A. $y=\frac{1}{8}\left(\frac{e^{8x}}{8}+x-\frac{7}{8}\right)$

B. $y=\frac{1}{8}\left(\frac{e^{8x}}{8}+x+\frac{7}{8}\right)$

C. $y = \frac{1}{8}\left(\frac{e^{8x}}{8} - x + \frac{7}{8}\right)$

D. none of these

**Answer: C**

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**46.** Solution of differential equation $\frac{dy}{dx} = \frac{yf'(x) - y^2}{f(x)}$ is equal to

A. $xy = f(x) + c$

B. $xy = f(x) + cx$

C. $y(x + c) = f(x)$

D. $y = f(x) + x + c$

**Answer: C**

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**47.** Equation to the curve through (2, 1) whose slope at the point (x, y) is $\left(x^2+y^2\right)/2xy$ is

A. $2\left(x^2-y^2\right)=3x$

B. $2\left(y^2-x^2\right)=6y$

C. $x\left(x^2-y^2\right)=6$

D. None of these

**Answer: A**

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**48.** Solution of $ydx-xdy+y^2\sin xdx=0$ is equal to

A. $y=-x\cos x+cx$

B. $x=y\cos x+cy$

C. $y=x\cos x+cx$

D. $x=-y\cos x+cy$

**Answer: B**

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**49.** if $y + x\frac{dy}{dx} = x\frac{\phi(xy)}{\phi'(xy)}$ then $\phi(xy)$ is equation to

A. $ke^{x^2/2}$

B. $ke^{y^2/2}$

C. $ke^{xy/2}$

D. $ke^{xy}$

**Answer: A**

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**50.** The curve satisfying the differential equation $\frac{dy}{dx} = \frac{y(x+y^3)}{x(y^3-x)}$ and passing through (4,-2) is

A. $y^2 = -2x$

B. $y = -2x$

C. $y^3 = -2x$

D. none of these

**Answer: C**

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**51.** Solution of differential equation $ydx - xdy + y^2x^2\,dx = 0$ is equal to

A. $3x + x^3y = ky$

B. $3y + y^3x = ky$

C. $3y + y^{3x} = kx$

D. none of these

**Answer: A**

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**52.** The solution of the differential equation $\frac{dy}{dx} = \frac{x+y}{x}$ satisfying the condition y (1) = 1 is :

A. $y = \log x + x$

B. $y = x \log x + x^2$

C. $y = xe^{(x-1)}$

D. $y = x \log x + x$

**Answer: D**

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**53.** If $y = f(x)$ then $\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^3 \frac{d^2x}{dy^2}$ is equal to

A. 0

B. c (constant)

C. $2x^2$

D. $2y^2$

**Answer: A**

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**54.** Solve $\frac{x + y\frac{dy}{dx}}{y - x\frac{dy}{dx}} = x^2 + 2y^2 + \frac{y^4}{x^2}$

A. $\frac{y}{x} - \frac{1}{2(x^2 + y^2)} = c$

B. $\frac{x}{y} + \frac{1}{x^2 + y^2} = c$

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

D. $\frac{x}{y} - \frac{1}{2(x^2 + y^2)} = c$

**Answer: A**

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**55.** Solution of the differential equation $\frac{x+y\frac{dy}{dx}}{y-x\frac{dy}{dx}}=\frac{x\cos^2\left(x^2+y^2\right)}{y^3}$ is equal to

A. $\tan\left(x^2+y^2\right)=\frac{x^2}{y^2}+c$

B. $\cot\left(x^2+y^2\right)=\frac{x^2}{y^2}+c$

C. $\tan\left(x^2+y^2\right)=\frac{y^2}{x^2}+c$

D. $\cot\left(x^2+y^2\right)=\frac{y^2}{x^2}+c$

**Answer: A**

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**56.** The solution of $\frac{x\frac{dy}{dx}-y}{\sqrt{x^2-y^2}}=mx^2$ is given by

A. $\sin^{-1}\frac{y}{x}=\frac{mx^2}{2}+c$

B. $\sin^{-1}y=\frac{mx^2}{2}+cx$

C. $\frac{y}{x}=\frac{mx^2}{2}+c$

D. none

**Answer: A**

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**57.** $\left(x^2+y^2\right)dy = xydx$. If $y(x_0) = e, y(1) = 1$, then value of $x_0 =$

A. $\sqrt{3}e$

B. $\sqrt{e^2 - \frac{1}{2}}$

C. $\sqrt{\frac{e^2-1}{2}}$

D. $\sqrt{\frac{e^2+1}{2}}$

**Answer: A**

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**58.** If $xdy = y(dx + ydy), y > 0$ and $y(1) = 1$, then y (-3) is equal to

A. 1

B. 3

C. 5

D. $-1$

**Answer: B**

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**59.** Solution of the differential equation $\left\{y\left(1+\frac{1}{x}\right)+\sin y\right\}dx+\{x+\log x+x\cos y\}dy=0$ is :

A. $y+x\log x+x\sin y=c$

B. $x+y\log x+y\sin x=c$

C. $xy+y\log x+x\sin y=c$

D. $xy+x\log x+y\sin y=c$

**Answer: C**

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**60.** The Solution of the differential equation $ydx + \left(x + x^2y\right)dy = 0$ is

A. $-\frac{1}{xy} = c$

B. $-\frac{1}{xy} + \log y = c$

C. $\frac{1}{xy} + \log y = c$

D. $\log y = cx$

**Answer: B**

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**61.** The solution curve of $\frac{dy}{dx} = \frac{y^2 - 2xy - x^2}{y^2 + 2xy - x^2}, y(-1) = 1$ is

A. St. line

B. Circle

C. Parabola

D. Ellipse

**Answer: A**

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**62.** The solution of differential equation $xdy\left(y^2e^{xy}+e^{x/y}\right)=ydx\left(e^{x/y}-y^2e^{x/y}\right)$, is

A. $e^{xy}=e^{x/y}+c$

B. $e^{x/y}+\frac{y}{x}=xy$

C. $xy=\log\left(e^{x/y}+c\right)$

D. $e^{xy}=\log(xy+c)$

**Answer: A::C**

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**63.** Solution of the differential equation $\frac{dy}{dx} = \frac{y(x - y\log y)}{x(x\log x - y)}$ is :

A. $\frac{\log x}{x} - \frac{\log y}{y} = c$

B. $\frac{\log x}{x} + \frac{\log y}{y} = c$

C. $\frac{x\log x + y\log y}{xy} = c$

D. $\frac{x\log x - y\log y}{xy} = c$

**Answer: C**

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**64.** The solution of $x^2dy - y^2dx + xy^2(x - y)dy = 0,$ is

A. $\log\left(\frac{1}{y} - \frac{1}{x}\right) = \frac{y^2}{2} + c$

B. $\log\left(\frac{1}{y} - \frac{1}{x}\right) = \frac{x^2}{2} + c$

C. $\log\left(\frac{1}{y} - \frac{1}{x}\right) = y + c$

D. $\log\left(\frac{1}{y} - \frac{1}{x}\right) = x + c$

**Answer: A**

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**65.** If $y = \log\left(m \cos^{-1} x\right)$ is a solution of the differential equation $\left(1 - x^2\right)\frac{d^2y}{dx^2} - x\frac{dy}{dx} = ke^{-2y}$, then k =

A. $m^2$

B. $2m^2$

C. $-m^2$

D. $-2m^2$

**Answer: C**

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Problem Set 1 True And False

**1.** The diff. equation of the family of straight lines y = mx is $\frac{dy}{dx} - x = 0.$

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**2.** The differential equation of which $y = ax^2 + bx$ is the general solution, a, b being arbitrary constants is $x^2 \frac{d^2y}{dx^2} - 2x\frac{dy}{dx} + 2y = 0.$

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**3.** The solution of $\left(xy^2 + x\right)dx + \left(yx^2 + y\right)dy = 0$ is $\left(x^2 + 1\right)\left(y^2 + 1\right) = 0$

Watch Video Solution

**4.** The solution of $(e^x + 1)ydy + (y + 1)dx = 0$ is $e^{x+y} = k(y + 1)(1 + e^x).$

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**5.** If $\frac{dy}{dx} = \frac{e^x\left(\sin^2 x + \sin 2x\right)}{y(2\log y + 1)}$ then the solution of the equation is $y^2 \log y + c = e^x \sin^2 x$

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**6.** $(e^y + 1)\cos x dx + e^y \sin x dy = 0$. The solution of this diff. eqn. is $\cos x(e^y + 1) = c$.

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**7.** If $x\frac{dy}{dx} + \frac{y^2}{x} = y$, then $\frac{x}{y} = \log x + c$

Watch Video Solution

**8.** If $x^2\frac{dy}{dx} = \frac{y(x+y)}{2}$, then $(y-x)^2 = kx^2y$

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## Problem Set 1 Fill In The Blanks

**1.** The diff. equation of the family of parabolas $y^2 = 4ax$ is .....

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**2.** The diff. equation whose solutions are $y = x\sin(x + A)$, A being constant is .....

Watch Video Solution

**3.** The differential equation of all circles passing through origin and having their centres on the x-axis is .....

Watch Video Solution

**4.** If $\frac{dy}{dx} + \sqrt{\left(\frac{1-y^2}{1-x^2}\right)} = 0$, then its solution is .....

Watch Video Solution

**5.** If $xy\frac{dy}{dx} = \frac{1+y^2}{1+x^2}(1+x+x^2)$, then its solution is .....

Watch Video Solution

**6.** If $\frac{dy}{dx} = \frac{1+y^2}{(1+x^2)xy}$, then its solution is .....

Watch Video Solution

**7.** If $\frac{dy}{dx} - x\tan(y-x) = 1$, then its solution is .....

Watch Video Solution

**8.** If $\frac{dy}{dx} = \frac{y(x-y)}{x(x+y)}$, then solution of the diff. equation is .....

Watch Video Solution

**9.** The solution of diff. eqn. $\left(x^2 - y^2\right)\frac{dy}{dx} = xy$ is .....

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## Problem Set 2 Multiple Choice Questions

**1.** Solution of the differential equation

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

A. $4xy = x^4 + c$

B. $xy = x^4 + c$

C. $4xy + x^4 = c$

D. None

**Answer: A**

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**2.** Solution of the differential equation

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

A. $(x-2)=ke^{-\tan^{-1}y}$

B. $2xe^{\tan^{-1}y}=e^{2\tan^{-1}y}+k$

C. $xe^{\tan^{-1}y}=\tan^{-1}y+k$

D. $xe^{2\tan^{-1}y}=e^{\tan^{-1}y}+k$

**Answer: B**

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

A. $y = x^3 + 3x^2 + 4x \log x + cx$

B. $y = x^2 + 3x + 4 \log x + c$

C. $y = x^3 + 3x^2 + 4 \log x + c$

D. None

**Answer: A**

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**4.** The solution of differential equation $\frac{dy}{dx} + \frac{y}{x} = \sin x$ is

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

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

C. $x(y + \cos x) = \cos x + c$

D. None

**Answer: A**

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**5.** Solution of the differential equation

$\frac{dy}{dx} + y\cot x = 2\cos x$ is

A. $y\sin x + \cos^2 x = c$

B. $y = \sin x + c\text{cosec}x$

C. $(y - \sin x)\sin x = c$

D. None

**Answer: A::B::C**

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**6.** Solution of the differential equation

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

A. $xe^{\tan^{-1} y} = \left(1 - \tan^{-1} y\right)e^{\tan^{-1} y} + c$

B. $xe^{\tan^{-1} y} = \left(\tan^{-1} y - 1\right)e^{\tan^{-1} y} + c$

C. $x = \tan^{-1} y - 1 + ce^{-\tan^{-1} y}$

D. None of these

**Answer: B::C**

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**7.** Solution of the differential equation $\left(1 + x^2\right)\frac{dy}{dx} + y = \tan^{-1} x$ is

A. $ye^{\tan^{-1} x} = \left(1 - \tan^{-1} x\right)e^{\tan^{-1} y} + c$

B. $ye^{\tan^{-1} x} = \left(\tan^{-1} x - 1\right)e^{\tan^{-1} x} + c$

C. $ye^{\tan^{-1} x} = \left(\tan^{-1} x - 1\right)e^{\tan^{-1} x} + c$

D. None of these

**Answer: B::C**

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**8.** Solution of the differential equation $2y\sin x(dy/dx) = 2\sin x\cos x - y^2\cos x, x = \pi/2, y = 1$, is given by

A. $y^2 = \sin x$

B. $y = \sin^2 x$

C. $y^2 = \cos x + 1$

D. None of these

**Answer: A**

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**9.** The Solution of the equation $\frac{dy}{dx} + 2y = \sin x$ is

A. $y = 5(2\sin x - \cos x) + ce^{-2x}$

B. $y = (2\sin x - \cos x) + ce^{-x}$

C. $y = (2\cos x - \sin x) + ce^{-2x}$

D. $y = \frac{1}{5}(2\sin x - \cos x) + ce^{-2x}$

**Answer: D**

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**10.** The Solution of the equation $\frac{dy}{dx} + y\tan x = \sec x$ is

A. $y = \sin x + c\cos x$

B. $y = \sin x - c\cos x$

C. $y = \tan x + \cot x + c$

D. None of these

**Answer: A**

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**11.** The Solution of the equation $x\log x\frac{dy}{dx} + y = 2\log x$ is

A. $y = \log x + \frac{c}{\log x}$

B. $y = \log x - \frac{c}{\log x}$

C. $y = \log x - c \log x$

D. None of these

**Answer: A**

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**12.** Solution of the differential equation $x\frac{dy}{dx} + 2y = x^2 \log x$ is

A. $y = \frac{x^2}{4}\log x + x^2 + cx^2$

B. $y = \frac{x^2}{4}\log x + \frac{x^2}{4} + cx^{-2}$

C. $y = \frac{x^2}{4}\log x - \frac{x^2}{16} + cx^{-2}$

D. None of these

**Answer: C**

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**13.** The Solution of the equation

$$(1+x^2)\frac{dy}{dx}+2xy-4x^2=0$$

A. $y(1+x^2)=x^3+c$

B. $y(1+x^2)=2x+c$

C. $y(1+x^2)=\frac{4}{3}x^3+c$

D. None

**Answer: C**

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**14.** The solution of differential equation $\frac{dy}{dx}-3y=\sin 2x$ is

A. $y=e^{-3x}\left(\frac{\cos 2x+3\sin 2x}{13}\right)+c$

B. $y=e^{-3x}\left(\frac{\cos 2x-3\sin 2x}{13}\right)+c$

C. $ye^{-3x}=-e^{-3x}\left(\frac{2\cos 2x+3\sin 2x}{13}\right)+c$

D. None

**Answer: C**

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**15.** The solution of the equation $\frac{dy}{dx} + 3y = \cos^2 x$ is

A. $y = \frac{1}{6} + \frac{1}{26}(2\sin 2x + 3\cos 2x) + ce^{-3x}$

B. $y = \frac{1}{6} + \frac{1}{26}(3\cos 2x + 2\sin 2x) + ce^{-3x}$

C. $y = \frac{1}{6} + \frac{1}{26}(3\cos 2x - 2\sin 2x) + ce^{3x}$

D. None of these

**Answer: A**

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**16.** The gradient of the curve passing through $(4, 0)$ is given by $\frac{dy}{dx} - \frac{y}{x} + \frac{5x}{(x+2)(x-3)} = 0$ if the point ( 5,a) lies on the curve then the value of a is

A. $\frac{67}{12}$

B. $5\sin\frac{7}{12}$

C. $5\log\frac{7}{12}$

D. none of these

**Answer: C**

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**17.** Solution of the differential equation $\sin 2x\frac{dy}{dx} - y = \tan x$ is

A. $y = \tan x + c\sqrt{\tan x}$

B. $x - y\sin x = c$

C. $xy\tan x = c$

D. none of these

**Answer: A**

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**18.** The Solution of the differential equation $\frac{dy}{dx} + \frac{1}{x}\tan y = \frac{1}{x^2}\tan y \sin y$ is

A. $2x = \sin y\left(1 + 2cx^2\right)$

B. $2x = \sin y\left(1 + cx^2\right)$

C. $2x + \sin y\left(1 + cx^2\right) = 0$

D. none of these

**Answer: A::B**

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**19.** Solution of the equation $\frac{dy}{dx} = e^{x-y}(e^x - e^y)$ is equal to

A. $e^y = e^x - 1 + ce^{-e^x}$

B. $e^{y-x} = -1 + ce^{-x}$

C. $e^x + e^y = ce^{e^x}$

D. none of these

**Answer: A**

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**20.** If y(t) is solution of $(t+1)\frac{dy}{dt} - ty = 1, y(0) = -1$. At t = 1 the solution is

A. $e + \frac{1}{2}$

B. $-\frac{1}{2}$

C. $\frac{1}{2}$

D. $e - \frac{1}{2}$

**Answer: B**

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**21.** The solution of differential equation $\frac{dy}{dx}\left(x^2y^3+xy\right)=1$ is :

A. $\frac{1}{x}=2-y^2+ce^{-y^2/2}$

B. $\frac{2}{x}=1-y^2+c.\,e^{-y/2}$

C. $\frac{T-2x}{x}=-y^2+ce^{-y^2/2}$

D. Reducible to linear

**Answer: A**

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**22.** The solution of the differential equation

$\frac{dy}{dx}-\frac{x\log x}{1+\log x}=\frac{e^y}{1+\log x}$ if y(1) = 0, is :

A. $x^x = e^{ye^y}$

B. $e^y = x^{e^y}$

C. $x^x = ye^y$

D. none

**Answer: A**

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**23.** If $\frac{dy}{dx} + Py = Q$ where P and Q are functions of x alone then integrating factor I.F. $= e^{\int pdx}$

where $e^{\log x} = x, e^{2\log x} = e^{\log x^2} = x^2, e^{-\log x} = x^{-1}$

Match the following:

| Column I | Column II<br>I.F. = |
|---|---|
| (a) $\frac{dy}{dx} + x\sin 2y = x^2\cos^2 y$ | 1. $y^2$ |
| (b) $x(x-1)\frac{dy}{dx} - (x-2)y = x^2(2x-1)$ | 2. $e^{x^2}$ |
| (c) $(x+y+1)\frac{dy}{dx} = 1$ | 3. $\frac{x-1}{x^2}$ |
| (d) $(2x - 10y^3)dy + y\,dx = 0$ | 4. $f(x)$ |
| (e) $\frac{dy}{dx} = \frac{y f'(x) - y^2}{f(x)}$ | 5. $e^{-y}$ |

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

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

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

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

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

**Answer: A**

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## Problem Set 2 True And False

**1.** Solution of the differential equation is

$(1-x^2)(dy/dx)+2xy=x\sqrt{(1-x^2)}$ Then

$y\sqrt{(1-x^2)}=c(1-x^2)$ . True or False

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**2.** Solution of the differential equation

$x\frac{dy}{dx}+y\log y=xye^x$ is

$x\log y=e^x(x-1)+c,$

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**3.** Solution of the differential equation

$(1+x^2)(dy/dx)+2xy=\cos x$ is

$y(1+x^2)=\sin x+c.$

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**4.** Solution of the differential equation

$\frac{dy}{dx}+y\sec x=\tan x$ is

$y(\sec x+\tan x)=\sec x+\tan x-x+c.$

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**5.** Solution of the differential equation

$\cos x\frac{dy}{dx}+y\sin x=\sec^2 x$ is

$y\sec x=\tan x+\frac{\tan^3 x}{3}+c.$

Is this statement true?

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**6.** Solution of the differential equation

$(1+y+x^2y)dx+(x+x^3)dy=0$ is

$xy-\tan^{-1}x=c.$

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**7.** Solution of the differential equation

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

$x^2-y^2-1+cx=0$. True or False

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**8.** Solution of the differential equation

$\sec^2 y\frac{dy}{dx}\tan y=x^3$ is

$\tan y=x^3-3x^2+6x-6+ce^{-x}$

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**9.** The solution of the differential equation

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

is $y = x^3 + \frac{cx^2}{x-1}$ . True or False

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## Problem Set 2 Fill In The Blanks

**1.** Solution of the diff. eqn. $\left(1-x^2\right)\frac{dy}{dx} + xy = xy^2$ is .....

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**2.** Solution of the diff. eqn. $\sin y(dy/dx) = \cos y(1 - x\cos y)$ is .....

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**3.** Solution of the diff. eqn. $\frac{dy}{dx} + \frac{1}{x} = \frac{e^y}{x^2}$ is .....

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**4.** Solution of the diff. eqn. $(1+x)\frac{dy}{dx} - xy = 1 - x$ is .....

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**5.** Solution of the diff. eqn. $dx + xdy = e^{-y}\sec^2 ydy$ is .....

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**6.** $\cos^2 x\frac{dy}{dx} + y = \tan x$. The solution of this diff. eqn. is .....

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**7.** Solution of diff. eqn. $\sec x\frac{dy}{dx} = y + \sin x$ is .....

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**8.** Solution of diff. eqn. $\frac{dy}{dx} - \frac{\tan y}{1+x} = (1+x)e^x \sec y$ is .....

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**9.** Solution of diff. eqn. $\tan y \frac{dy}{dx} + \tan x = \cos y \cos^3 x$ is .....

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**10.** Solution of diff. eqn. $\frac{dy}{dx} + x \sin 2y = x^3 \cos^2 y$ is .....

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## Problem Set 3 Multiple Choice Questions

**1.** Equation of the curve in which the subnormal is twice the square of the ordinate is given by

A. $\log y = 2x + \log c$

B. $y = ce^{2x}$

C. $\log y = 2x^2 - \log c$

D. None of these

**Answer: A::B**

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**2.** Equation of the curve through the point (1, 0) which satisfies the differential equation $\left(1 + y^2\right)dx - xydy = 0$ is

A. $x^2 + y^2 = 1$

B. $x^2 - y^2 = 1$

C. $2x^2 + y^2 = 2$

D. None of these

**Answer: B**

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**3.** A curve passes through the point (5, 3) and at any point (x,y) on it, the product of its slope and the ordinate is equal to its abscissa. Its equation is given by

A. $x^2 + y^2 = 34$

B. $x^2 - y^2 = 16$

C. $5y - 3x = 0$

D. None of these

**Answer: B**

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**4.** Equation of the curve whose slope at the point (x,y) is -(x + y) / x and which passes through the points (2, 1) is

A. $2y^2 + xy = 4$

B. $y^2 + xy = 3$

C. $x^2 + 2xy = 8$

D. None of these

**Answer: C**

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**5.** The differential equation $\frac{dy}{dx} + \frac{9x}{4y} = 0$ represents a family of

A. concentric circles with centre at (3, 2)

B. ellipses with $e = \frac{1}{3}\sqrt{5}$

C. hyperbolas with $e = \frac{1}{2}\sqrt{5}$

D. parallel lines with $m = 3/2$

**Answer: B**

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**6.** The tangent at any point P of a curve meets the axis of x in T. The curve for which OP= PT,O being the origin is

A. circle

B. parabola

C. ellipse

D. None of these

**Answer: D**

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**7.** The slope of the curve at any point is the reciprocal of twice the ordinate at the point. The curve also passes through the point (4,3). It is a parabola .....

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**8.** The curve for which the normal at every point passes through a fixed point is a circle. Is this statement true or false?

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**9.** The curve for which normal at any point (x, y) and the line joining origin to that point form an isosceles triangle with x-axis is

A. circle

B. parabola

C. ellipse

D. rectangular hyperbola

**Answer: D**

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**10.** The equation of the curve passing through the point $\left(1, \frac{\pi}{4}\right)$ and having slope of tangent at any point (x, y) as $\frac{y}{x} - \cos^2 \frac{y}{x}$ is equal to

A. $x = e^{1-\tan(y/x)}$

B. $y = x \tan^{-1}(\log x / e)$

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

D. $x = e^{1+\cot(y/x)}$

**Answer: A::C**

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**11.** A curve passing through the point(1, 1) is such that the intercept made by a tangent to it on x-axis is three times the x co-ordinate of the point of tangency, then the equation of the curve is :

A. $y = \frac{1}{x^2}$

B. $y = \sqrt{x}$

C. $y = \frac{1}{\sqrt{x}}$

D. none

**Answer: C**

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## Self Assessment Test

**1.** The differential equation which represents the family of curves $y = c_1 e^{c_2 x}$, $c_1$ and $c_2$ are constants is

A. $y' = y^2$

B. $y'' = y'y$

C. $yy'' = y'$

D. $yy'' = (y')^2$

**Answer: D**

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**2.** The differential equation of the family of circles with fixed radius 5 units and centre on the line $y = 2$ is

A. $(y-2)y'^2 = 25 - (y+2)^2$

B. $(y-2)^2y'^2 = 25 - (y-2)^2$

C. $(x-2)^2y'^2 = 25 - (y-2)^2$

D. $(x-2)y'^2 = 25 - (y+2)^2$

**Answer: B**

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**3.** The solution of the differential equation $\frac{dy}{dx} = \frac{x+y}{x}$ satisfying the conditions y(1)=1 is

A. $y = x\log x + x^2$

B. $y = xe^{(x-1)}$

C. $y = x \log x + x$

D. $y = \log x + x$

**Answer: C**

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**4.** Solution of the differential equation $\cos x dy = y(\sin x - y)dx, 0 < x < \frac{\pi}{2}$ is

A. $\sec x = (\tan x + c)y$

B. $y \sec x = \tan x + c$

C. $y \tan x = \sec x + c$

D. $\tan x = (\sec x + c).\, y$

**Answer: A**

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

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

B. $I - \frac{kT^2}{2}$

C. $I - \frac{k(T-t)^2}{2}$

D. $e^{-kT}$

**Answer: B**

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**6.** If y(x) satisfies the differential equation $y' - y\tan x = 2x\sec x$ and $y(0) = 0$, then

A. $y\left(\frac{\pi}{4}\right) = \frac{\pi^2}{8\sqrt{2}}$

B. $y'\left(\frac{\pi}{4}\right) = \frac{\pi^2}{18}$

C. $y\left(\frac{\pi}{3}\right) = \frac{\pi^2}{9}$

D. $y'\left(\frac{\pi}{3}\right) = \frac{4\pi}{3} + \frac{2\pi^2}{3\sqrt{3}}$

**Answer: A::D**

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**7.** Let $f:[1,\infty[ \to [2,\infty[$ be differentiable function such that f(1)=2. If $6\int_1^x f(t)dt = 3xf(x) - x^3 - 5$ for all $x \geq 1$, then the value of f(2) is

A. 6

B. 4

C. $\frac{1}{4}$

D. $\frac{1}{6}$

**Answer: A**

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**8.** Let $y'(x) + y(x)g'(x) = g(x)g'(x), y(0) = 0, x \in R$ where f'(x) denotes $\frac{d(f(x))}{dx}$ and g(x) is a given non-constant differentiable function of R with g(0)=g(2)=0. Then y(2) is equal to

A. 0

B. 1

C. 2

D. $-1$

**Answer: A**

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**9.** Let f be a real valued differentiable function on R such that f(1) =1. If the y-intercept of the tangent at any point P(x,y) on the curve y=f(x) is equal to the cube of the abscissa of P, then the value of f(-3) is equal to

A. 9

B. 10

C. $-9$

D. 10

**Answer: A**

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**10.** The differential equation representing the family of curves $y^2 = 2c\left(x + \sqrt{c}\right)$ where c is a positive parameter, is of

A. order 1

B. order 2

C. degree 3

D. degree 4

**Answer: A::C**

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**11.** At present a firm is manufacturing 2000 items. It is estimated that the rate of change of production p with respect to additional nuber of workers x is given by $\frac{dp}{dx} = 100 - 12\sqrt{x}$. If the firm employes 25 more workers,

A. 2500

B. 3000

C. 3500

D. 4500

**Answer: C**

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Miscellaneous Exercise Matching Entries

**1.** Match the entries of List-A and List-B.

| List-A | List-B |
|---|---|
| (a) The order and degree of the differential equation $\frac{d^4y}{dx^4} = y + \left(\frac{dy}{dx}\right)^4$ | 1. $\sin^{-1}\frac{y}{x} = \frac{mx^2}{2} + c$ |
| (b) If $\frac{2+\sin x}{y+1}\frac{dy}{dx} = -\cos x$ and $y = 1$ at $x = 0$, then the value of $y$ at $x = \frac{\pi}{2}$ is | 2. 4, 1 |
| (c) Solution of $x\frac{dy}{dx} = y + x\tan\frac{y}{x}$ is | 3. $\frac{1}{3}$ |
| (d) Solution of $\frac{x\frac{dy}{dx} - y}{\sqrt{x^2 - y^2}} = mx^2$ is | 4. $\sin\frac{y}{x} = cx$ |

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**2.** Match the entries of List-A and List-B.

| List-A | List-B |
|---|---|
| (a) Solution of differential equation $x\log x\frac{dy}{dx} + y = 2\log x$ is | 1. $y = ce^{2x}$ |
| (b) Solution of differential equation $\sin 2x\frac{dy}{dx} - y = \tan x$ is | 2. $y = \log x + \frac{c}{\log x}$ |
| (c) If in any curve subnormal is twice the square of ordinate, then the curve is | 3. $y = \tan x + c\sqrt{\tan x}$ |

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