MATHS

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ORDINARY DIFFERENTIAL EQUATIONS

Worked Example

1. Determine the order and degree (if exists) of the following equations .

$$\frac{d^3y}{dx^3} + \left(\frac{d^2y}{dx^2}\right)^2 + \left(\frac{dy}{dx}\right)^5 + 4y = 0$$

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2. Determine the order and degree (if exists) of the following equations .

$$\left(\frac{d^4y}{dx^4}\right)^2 + 4\left(\frac{dy}{dx}\right)^{10} + 3y = 5\sin x$$

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3. Determine the order and degree (if exists) of the following equations .

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

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4. Determine the order and degree (if exists) of the following equations .

$$\frac{d^2y}{dx^2} = \left[1 + \left(\frac{dy}{dx}\right)^2\right]^{\frac{3}{2}}$$

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5. Determine the order and degree (if exists) of the following equations .

$$(1+y)^2 = y^2$$

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6. Determine the order and degree (if exists) of the following equations .

$$\frac{d^2y}{dx^2} = \left(3 + \frac{dy}{dx}\right)^{\frac{1}{4}}$$

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7. Determine the order and degree (if exists) of the following equations .

$$dy + (xy - \sin x)dx = 0$$

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8. Determine the order and degree (if exists) of the following equations .

$$\frac{dy}{dx} + 3y + 2\frac{dx}{dy} = 0$$

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9. Find the differential equation for the family of all straight lines passing through the origin

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10. Form the differential equation by eliminating the arbitary constants A and B from $y = A\cos 2x + B\sin 2x$

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11. Find the differential equation of the family of parabolas $y^2 = 4$ ax where a is an arbitrary constant .

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12. Form the differential equation from $Ax^2 + By^2 = 1$

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13. Form the differential equation from $y^2 = 4a(x - a)$

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14. Show that $y^2 = 4ax$ is a solution of the differential equation $\frac{dy}{dx} = \frac{2a}{y}$

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15. Show that $y = mx + \frac{3}{m}(m \neq 0)$ is a solution of differential equation .

$xy' + 3(y') - y = 0$

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16. Show that $y = \sin\left(m \sin^{-1} x\right)$ is a solution of the differential equation

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

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17. Show that $y = \left(\cos^{-1} x\right)^2$ is a solution of the differential equation .

$$\left(1 - x^2\right) y'' - xy' - 2 = 0$$

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18. Solve

$$\frac{dy}{dx} = \sqrt{\frac{4 - y^2}{4 - x^2}}$$

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19. Solve

$(1+x^2)dy = xydx$ given that $y(0) = 1$

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20. Solve

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

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21. Solve

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

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22. Solve

$$\frac{dy}{dx} = \frac{x + y + 1}{2x + 2y + 5}$$

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23. Solve

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

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24. Solve

$$\left(x^3 - 3xy^2\right)dx + 2x^2ydy = 0$$

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25. Solve

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

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26. Solve

$$xdy - ydy\left(\sqrt{x^2 + y^2}\right)dx$$

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27. Solve

$$\frac{dy}{dx} = \frac{xy - 2y^2}{x^2 - 3xy}$$

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28. Solve

$$\sqrt{1 - y^2}dx = \left[\sin^{-1}(y - x)\right]dy$$

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29. Solve

$$\frac{dy}{dx} + 3y \tan x = 3x^2 \cos^3 x$$

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30. Solve

$$ye^y dx = \left(y^4 = 3xe^y\right) dy$$

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31. Solve

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

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32. Solve

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

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33. The rate at which the population of a city increases at any times is proportional to the population anticipated after 3 more years .

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34. A radioactive substance disintegrates at a rate proportional to its mass . When its mass is 100 mgm , the rate of integration is 0.051 mgm per day . How long will it take for the mass to be reduced from 100 mgm to 50 mgm

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35. A cup of coffee at temperature $100^{\circ} C$ is placed in a room whose temperature is $20^{\circ} C$ and it costs to $60^{\circ} C$ in 10 minutes find the temperature after a further interval of 10 minutes .

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36. A tank contains 1000 litres of water in which 100 grams of salt is dissolved Salt solution runs at a rate 10 litres per minute , each litre contains 5 grams of dissolved salt . The mixture of the tank is kept uniform by stirring . Salt solution runs out at 20 litres per minute . Find the amount of salt at any time .

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Solution To Exercise 10 1

1. Determine its order, degree (if exists)

$$\frac{dy}{dx} + xy = \cot x$$

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2. Determine its order, degree (if exists)

$$\left(\frac{d^3y}{dx^3}\right)^{\frac{2}{3}} - 3\frac{d^2y}{dx^2} + 5\frac{dy}{dx} + 4 = 0$$

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3. For each of the following differential equations , determine its order , degree (if exist)

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

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4. Determine its order, degree (if exists)

$$\sqrt{\frac{dy}{dx}} - 4\frac{dy}{dx} - 7x = 0$$

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5. Determine its order, degree (if exists)

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

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6. Determine its order, degree (if exists)

$$x^2 \frac{d^2y}{dx^2} + \left[1 + \left(\frac{dy}{dx}\right)^2\right]^{\frac{1}{2}} = 0$$

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7. Determine its order, degree (if exists)

$$\left(\frac{d^2y}{dx^2}\right)^3 = \sqrt{1 + \left(\frac{dy}{dx}\right)}$$

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8. Determine its order, degree (if exists)

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

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9. Determine its order, degree (if exists)

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

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10. Determine its order, degree (if exists)

$$x = e^{xy\left(\frac{dy}{dx}\right)}$$

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Solution To Exercise 10 2

1. Express each of the following physical statements in the form of differential equation.

(i) Radium decays at a rate proportional to the amount Q present.

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2. Express each of the following physical statements in the form of differential equation.

(ii) The population P of a city increases at a rate proportional to the product of population and to the difference between 5,00,000 and the population.

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3. Express each of the following physical statements in the form of differential equation.

(iii) For a certain substance, the rate of change of vapor pressure P with respect to temperature T is

proportional to the vapor pressure and inversely proportional to the square of the temperature.

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4. Express each of the following physical statements in the form of differential equation.

(iv) A saving amount pays 8% interest per year, compounded continuously. In addition, the income from another investment is credited to the amount continuoulsy at the rate of Rs. 400 per year.

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5. Assume that a spherical rain drop evaporates at a rate proportional to its surface area. Form a differential equation involving the rate of change of the radius of the rain drop.

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Solution To Exercise 10 3

1. Find the differential equation of the family of (i) all non- vertical lines in a plane

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2. Form the differential equation of all straight lines touching the circle $x^2 + y^2 = r^2$.

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3. Find the differential equation of the family of circles passing through the origin and having their centres on the x - axis.

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4. Find the differential equation of the family of all the parabolas with latus rectum 4a and whose axes are parallel to the x-axis.

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5. Find the differential equation of the family of parabolas with vertex at $(0, -1)$ and having axis along the y-axis.

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6. Find the differential equations of the family of all the ellipses having foci on the y-axis and centre at the origin.

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7. Find the differential equation corresponding to the family of curves represented by the equation $y = Ae^{8x} + Be^{-8x}$, where A and B are arbitrary constants.

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8. Find the differential equation of the curve represented by $xy = ae^{x} + be^{-x} + x^{2}$.

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Solution To Exercise 10 4

1. Show that each of the following expressions is a solution of the corresponding given differential equation.

$(i) y = 2x^{2}; xy' = 2y$

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2. Show that each of the following expressions is a solution of the corresponding given differential equation.

$(ii) y = ae^{x} + be^{-x}; y'' - y = 0$

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3. Find value of m so that the function $y = e^{mx}$ is a solution of the given differential equation.

$y' + 2y = 0$

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4. Find value of m so that the function $y = e^{mx}$ is a solution of the given differential equation.

$y'' - 5y' + 6y = 0$

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5. The slope of the tangent to the curve at any point is the reciprocal of four times the ordinate at that point. The curve passes through (2, 5). Find the equation of the curve.

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6. Show that $y = e^{-x} + mx + n$ is a solution of the differential equation $e^x \frac{d^2y}{dx^2} - 1 = 0$.

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7. Show that $y = ax + \frac{b}{x}, x \neq 0$ is a solution of the differential equation $x^2y'' + xy' - y = 0$.

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8. Show what $y = ae^{-3x} + b,$ where a and b are arbitary constants, is a solution of the differential

equation $\frac{d^2y}{dx^2} + 3\frac{dy}{dx} = 0$

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9. Show that the differential equation representing the family of curves $y^2 = 2a\left(x + a^{\frac{2}{3}}\right)$ where a is positive parameter, s $\left(y^2 - 2xy\frac{dy}{dx}\right)^3 = 8\left(y\frac{dy}{dx}\right)^5$

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10. Show that $y = a\cos bx$ is a solution of the differential equation $\frac{d^2y}{dx^2} + b^2y = 0.$

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Solution To Exercise 10 5

1. If F is the constant force generated by the motor of an automobiles of mass M, its velocity V is given by $M\frac{dV}{dt} = F - kV$, where k is a constant. Express V in terms of t given that V = 0 when t = 0.

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2. The velocity v, of a parachute falling vertically satisfies the equation $v\frac{dv}{dx} = g\left(1 - \frac{v^2}{k^2}\right)$, where g and k are constants. If v and x are both initially zero, find v in terms of x.

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3. Find the equation of the curve whose slope is $\frac{y-1}{x^2+x}$ and which passes through the point (1,0).

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4. Solve the differential equations :

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

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5. Solve the differential equations :

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

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6. Solve the differential equations :

$$\sin. \frac{dy}{dx} = a, y(0) = 1$$

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7. Solve the differential equations :

$$\frac{dy}{dx} = e^{x+y} + x^3 e^y$$

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8. Solve the differential equations :

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

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9. Solve the differential equations :

$$(ydx - xdy)\cot\left(\frac{x}{y}\right) = ny^2dx$$

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10. Solve the differential equations :

$$\frac{dy}{dx} - x\sqrt{25 - x^2} = 0$$

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11. Solve the differential equations :

$$x\cos ydy = e^x(x\log x + 1)dx$$

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12. Solve the differential equations :

$$\tan y.\ \frac{dy}{dx} = \cos(x+y) + \cos(x-y)$$

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13. Solve the differential equations :

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

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Solution To Exercise 10 6

1. Solve the differential equations :

$$\left[x + y\cos\left(\frac{y}{x}\right)\right]dx = x\cos\left(\frac{y}{x}\right)dy$$

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2. Solve the differential equations :

$$\left(x^3 + y^3\right)dy - x^2 ydx = 0$$

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3. Solve the differential equations :

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

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4. Solve the differential equations :

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

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5. Solve the differential equations :

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

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6. Solve the following differential equations :

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

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7. $\left(1 + 3e^{\frac{y}{x}}\right)dy + 3x^{\frac{y}{x}}\left(1 - \frac{y}{x}\right)dx = 0$, given that $y = 0$ and $x = 1$

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8. $\left(x^2 + y^2\right)dy = xydx$. It is given that $y(1) = 1$ and $y(x_0) = e$. Find the vale of x_0.

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Solution To Exercise 10 7

1. Solve the following Linear differential equations :

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

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

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3. $\frac{dy}{dx} + \frac{y}{x} = \sin x$

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4. $\left(x^2 + 1\right)\frac{dy}{dx} + 2xy = \sqrt{x^2 + 4}$

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5. $\left(2x - 10y^3\right)dy + ydx = 0$

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6. $x \sin x \frac{dy}{dx} + (x \cos x + \sin x)y = \sin x$

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

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8. Solve the following linear differential equation

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

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9. $\left(1+x+xy^2\right)\frac{dy}{dx}+\left(y+y^3\right)=0$

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10. $\frac{dy}{dx}+\frac{y}{x\log x}=\frac{\sin 2x}{\log x}$

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11. $(x+a)\frac{dy}{dx}-2y=(x+a)^4$

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12. $\frac{dy}{dx} = \frac{\sin^2 x}{1+x^3} - \frac{3x^2}{1+x^3}y$

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13. $x\frac{dy}{dx} + y = x\log x$

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14. $x\frac{dy}{dx} + 2y - x^2\log x = 0$

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15. $\frac{dy}{dx} + \frac{3y}{x} = \frac{1}{x^2}$, given that y = 2 when x = 1.

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Solution To Exercise 10 8

1. The 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, find how many bacteria will be present after 10 hours ?

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2. Find the population of a city at any time t, given that the rate of increase of population is proportional to the population at that instant and that in a period of 40 years the population increased from 3,00,000 to 4,00,000.

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3. The equation of electromotive force for an electric circuit containing resistance and self inductance is $E = Ri + L\frac{di}{dt}$, where E is the electromotive force is given to the circuit, R the

resistance and L, the coefficient of induction. Find the current i at time t when E = 0.

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4. The engine of a motor boat moving at 10 m/s is shut off. Given that the restardation at any subsequent time (aftere shutting off the engine) equal to the velocity at that time. Find the velocity after 2 seconds of switching off the engine.

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5. Suppose a person deposits 10,000 Indian rupees in a bank account at the rate of 5% per annum compounded continuously. How much money will be in his bank account 18 months later?

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6. Assume that the rate at which radioactive nuclei decay is proportioanl to the number of such nuclei that are present in a given sample. In a certain sample 10% of the original number of radioactive nuclei have undergone disintegration in a period of

100 years. What percentage of the original radioactive nuclei will remain after 1000 years.?

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7. Water at temperature $100^\circ C$ cools in 10 minutes to $80^\circ C$ in a room temperature of $25^\circ C$.

Find

(i) The temperature of water after 20 minutes

$$\left[\log_e . \frac{11}{15} = -0.3101, \log_e 5 = 1.609\right]$$

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8. Water at temperature $100^\circ C$ cools in 10 minutes to $80^\circ C$ in a room temperature of $25^\circ C$.

Find

(i) The temperature of water after 20 minutes

(ii) The time when the temperature is $40^\circ C$

$$\left[\log_e \frac{11}{15} = -0.3101, \log_e 5 = 1.6094\right]$$

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9. At 10.00 A.M. a woman took a cup of hot instant coffe from her microwave oven and placed it on a nearby Kitchen counter to cool. At this instant the temperature of the coffee was $180^\circ F$, and 10

minutes later it was $160^\circ F$. Assume that constant temperature of the kitchen was $70^\circ F$.

(i) What was the temperature of the coffee at 10.15 A.M. ?

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10. At 10.00 A.M. a woman took a cup of hot instant coffe from her microwave oven and placed it on a nearby Kitchen counter to cool. At this instant the temperature of the coffee was $180^\circ F$, and 10 minutes later it was $160^\circ F$. Assume that constant temperature of the kitchen was $70^\circ F$.

The woman likes to drink coffe when its

temperature is between $130^\circ F$ and $140^\circ F$. between what time should she have drunk the coffee?

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11. A pot of boiling water at $100^\circ C$ is removed from a stove at time t = 0 and left to cool in the kitchen. After 5 minutes, the water temperature has decreased to $80^\circ C$, and another 5 minutes later it has dropped to $65^\circ C$. Determine the temperature of the kitchen.

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12. A tank initially contains 50 litres of pure water. Starting at time t = 0 a brine containing with 2 grams of dissolved salt per litre flows into the tank at the rate of 3 litres per minutes. The mixture is kept uniform by stirring and the well - stirred mixture simultaneously flows out of the tank at the same rate. Find the amount of salt present in the tank at any time $t > 0$.

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Solution To Exercise 10 9

1. The order and degree of the differential equation $\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^{\frac{1}{3}} + x^{\frac{1}{4}} = 0$ are respectively.

A. $2, 3$

B. $3, 3$

C. $2, 6$

D. $2, 4$

Answer: A

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2. The differential equation representing the family of curves $y = A\cos(x + B)$, where A and B are parameters, is

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

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

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

D. $\frac{d^2x}{dy^2} = 0$

Answer: B

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3. The order and degree of the different equation $\sqrt{\sin x}(dx + dy) = \sqrt{\cos x}(dx - dy)$ is

A. $1, 2$

B. $2, 2$

C. $1, 1$

D. $2, 1$

Answer: C

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4. The order of the differential equation of all circles with centre at (h,k) and radius 'a' is .....

A. 2

B. 3

C. 4

D. 1

Answer: A

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5. The differential equation of the family of curves $y = Ae^x + be^{-x}$, where A and B are arbitrary constant is

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

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

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

D. $\frac{dy}{dx} - y = 0$

Answer: B

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6. The general solution of the differential equation $\frac{dy}{dx} = \frac{y}{x}$ is

A. $xy = k$

B. $y = k \log x$

C. $y = kx$

D. $\log y = kx$

Answer: C

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7. The solution of the differential equation $2x\frac{dy}{dx} - y = 3$ represents

A. straight lines

B. circles

C. parabola

D. ellipse

Answer: C

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8. The solution of $\frac{dy}{dx} + p(x)y = 0$ is

A. $y = ce^{\int pdx}$

B. $y = ce^{-\int pdx}$

C. $x = ce^{-\int pdy}$

D. $x = ce^{\int pdy}$

Answer: B

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9. The integrating factor of the differential equation $\frac{dy}{dx} + y = \frac{1+y}{x}$ is

A. $\frac{x}{e^{\lambda}}$

B. $\frac{e^{\lambda}}{x}$

C. λe^{x}

D. e^{x}

Answer: C

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10. The integrating factor of the differential equation $\frac{dy}{dx} + P(x)y = Q(x)$ is x, then $P(x)$

A. x

B. $\frac{x^2}{2}$

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

D. $\frac{1}{x^2}$

Answer: C

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11. The degree of the differential equation $y(x) = 1 + \frac{dy}{dx} + \frac{1}{1.2}\left(\frac{dy}{dx}\right)^2 + \frac{1}{1.2.3}\left(\frac{dy}{dx}\right)^3 + \ldots$ is

A. 2

B. 3

C. 1

D. 4

Answer: C

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12. If p and q are the oder and degree of the differential equation $y\frac{dy}{dx} + x^3\left(\frac{d^2y}{dx^2}\right) + xy = \cos x,$ when

A. $p < q$

B. $p = q$

C. $p > q$

D. p exists and q does not exist

Answer: C

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13. The solution of the differential equation $\frac{dy}{dx} + \frac{1}{\sqrt{1-x^2}} = 0$ is

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

B. $x + \sin^{-1} y = 0$

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

D. $x^2 + 2\sin^{-1} y = 0$

Answer: A

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14. The solution of the differential equation $\frac{dy}{dx} = 2xy$ is

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

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

C. $y = Ce^{-x^2} + c$

D. $y = x^2 + c$

Answer: A

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15. The general solution of the differential equation $\log\left(\frac{dy}{dx}\right) = x + y$ is

A. $e^x + e^y = c$

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

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

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

Answer: B

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16. The solution of $\frac{dy}{dx} = 2^{y-x}$ is

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

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

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

D. $x + y = c$

Answer: C

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17. The solution of the differential equation $\frac{dy}{dx} = \frac{y}{x} + \frac{\phi\left(\frac{y}{x}\right)}{\phi'\left(\frac{y}{x}\right)}$ is

A. $x\phi\left(\frac{y}{x}\right) = k$

B. $\phi\left(\frac{y}{x}\right) = kx$

C. $y\phi\left(\frac{y}{x}\right) = k$

D. $\phi\left(\frac{y}{x}\right) = ky$

Answer: B

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18. If $\sin x$ is the integrating factor of the linear differential equation $\frac{dy}{dx} + Py = Q$, then P is

A. $\log \sin x$

B. $\cos x$

C. $\tan x$

D. $\cot x$

Answer: D

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19. The number of arbitrary constants in the general solutions of order n and $n+1$ are respectively

A. $n-1, n$

B. $n, n+1$

C. $n+1, n+2$

D. $n+1, n$

Answer: B

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20. The number of arbitrary constants in the particular solution of a differential equation of third order is

A. 3

B. 2

C. 1

D. 0

Answer: D

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21. Integrating factor of the differential equation is $\frac{dy}{dx} = \frac{x+y+1}{x+1}$ is

A. $\frac{1}{x+1}$

B. $x+1$

C. $\frac{1}{\sqrt{x+1}}$

D. $\sqrt{x+1}$

Answer: A

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22. The population P in any year t is such that the rate of increase in the population is proportional to the population. Then

A. $P = ce^{kt}$

B. $P = ce^{-kt}$

C. $P = ckt$

D. $P = c$

Answer: A

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23. P is the amount of certain substanc left in after time t. If the rate of evaporation of the substance is proportional to the amount remaining, then

A. $P = ce^{kt}$

B. $P = ce^{-kt}$

C. $P = ckt$

D. $Pt = c$

Answer: B

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24. If the solution of the differential equation $\frac{dy}{dx} = \frac{ax+3}{2y+f}$ represents a circle , then the value of a is :

A. 2

B. -2

C. 1

D. -1

Answer: B

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25. The slope at any point of a curve $y = f(x)$ is given by $\frac{dy}{dx} = 3x^2$ and it passes through $(-1, 1)$. Then the equation of the curve is

A. $y = x^3 + 2$

B. $y = 3x^2 + 4$

C. $y = 3x^3 + 4$

D. $y = x^3 + 5$

Answer: A

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Problems For Practice Choose The Correct Answer

1. The order and degree of $\left(\frac{dy}{dx}\right)^3 + 5y^{\frac{1}{3}} = x^{\frac{2}{3}}$ are :

A. $(1, 3)$

B. $(2, 6)$

C. $(1, 2)$

D. $(3, 3)$

Answer: A

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2. The intergrating function of $\frac{dx}{dy} + Px = Q$ is :

A. $\int P dy$

B. $e^{\int P dy}$

C. $e^{\int P dx}$

D. $\int Q dy$

Answer: B

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3. If $y = ax^2 + bx + c = 0$ where a,b,c are arbitrary constants then the differential equation is :

A. $y'''+y''=0$

B. $y''=2a$

C. $y'''=0$

D. $y''-y=0$

Answer: C

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4. $y=ce^{kx}$ is the solution of the differential equation :

A. $\frac{dx}{dy}=-kx$

B. $\frac{dx}{dy} = kx$

C. $\frac{dy}{dx} = -kx$

D. $\frac{dy}{dx} = ky$

Answer: D

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5. The order and degree of the differential equation $\sin x(dx + dy) = \cos x(dx - dy)$ are :

A. $(0, 0)$

B. $(2, 1)$

C. $(1, 2)$

D. $(1, 1)$

Answer: D

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6. The order and degree of the differential equation $\sin^3 x(dx + dy) = \cos^3 x(dx - dy)$ is :

A. $(1, 1)$

B. $(2, 1)$

C. $(2, 2)$

D. $(1, 2)$

Answer: C

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7. The differential equation for which solution is $y = ae^{3x} + be^{-3x}$ is :

A. $\frac{d^2y}{dx^2} - 3y = 0$

B. $\frac{d^2y}{dx^2} - 9y = 0$

C. $\frac{d^2y}{dx^2} + 9y = 0$

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

Answer: B

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8. The integrating factor of $\frac{dy}{dx} + \frac{1}{x \log x} y = \frac{2}{x^2}$ is :

A. logx

B. e^x

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

D. $\log \log x$

Answer: A

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9. The degree of the differential equation $(y' - 2y'')^2 = (y')^4$:

A. 2

B. 3

C. 4

D. 8

Answer: A

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10. If $f'(x) = \sqrt{x}$ and f(1) = 2 then f(x) is :

A. $\frac{2}{3}\left(x\sqrt{x}+2\right)$

B. $\frac{2}{3}\left(x\sqrt{x}+2\right)$

C. $\frac{3}{2}\left(x\sqrt{x}+2\right)$

D. $-\frac{2}{3}\left(x\sqrt{x}+2\right)$

Answer: B

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11. The order and degree of the differential equation $\frac{d^2y}{dx^2} - y\left(\frac{dy}{dx} + \frac{d^3y}{dx^3}\right) = 0$

A. $(2, 3)$

B. $(2, 2)$

C. $(3, 1)$

D. $(3, 2)$

Answer: C

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12. The differential equation of the family of lines $y = mx$ is :

A. $\frac{dy}{dx} = 0$

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

C. $ydx + xdy = 0$

D. $ydx - xdy = 0$

Answer: D

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13. If $\frac{dy}{dx} = \frac{x - y}{x + y}$ then its solution is :

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

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

C. $x^2 + y^2 - 2xy = c$

D. $x^2 - y^2 - 2xy = c$

Answer: D

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14. The integrating factor for $\frac{dy}{dx} - 2y \tan x = \cos x$ is :

A. $\cot^2 x$

B. $\tan^2 x$

C. $\cos^2 x$

D. $\sin^2 x$

Answer: C

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15. The integrating factor of $\frac{dy}{dx} + 2\frac{y}{x} = e^{4x}$ is :

A. x^{-2}

B. x^2

C. x

D. x^3

Answer: B

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16. Which of the following is a solution of $\frac{d^2y}{dx^2} + y = 0$:

A. $A\cos x + B\sin x$

B. $(Ax + B)e^x$

C. $(A + Bx)e^{-x}$

D. $(Ax + B)e^{2x}$

Answer: A

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17. The differential equation formed by eliminating A and B for the relation $y = e^x(A\cos x + B\sin x)$ is :

A. $y'' - 2y' + 2y = 0$

B. $y'' - y' = 0$

C. $y_2 - 2y_1 - 2y = 0$

D. $y'' + y' = 0$

Answer: A

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18. If $xy = a^2$ where a is arbitrary constant then :

A. $xy'' - x = 0$

B. $xy' + y = 0$

C. $y''x + 1 = 0$

D. $y'' = 0$

Answer: B

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19. The order and degree of the differential equation $y''\left(y-(y')^3\right)^{\frac{2}{3}}$ are :

A. $(3, 2)$

B. $(2, 2)$

C. $(2, 3)$

D. $(3, 3)$

Answer: C

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20. The degree of the differential equation $\rho = \frac{\left(1 + \left(\frac{dy}{dx}\right)^2\right)^{\frac{3}{2}}}{\frac{d^2y}{dx^2}}$ where ρ is a constant is :

A. -2

B. 1

C. 3

D. 2

Answer: D

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21. The order and degree of the differential equation $\left(\frac{dy}{dx}\right)^2 = x + \frac{d^2y}{dx^2}$ are :

A. $(2, 1)$

B. $(1, 1)$

C. $(1, 2)$

D. $(2, 1)$

Answer: D

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22. The solution of the equation $\frac{dx}{dy} + Px = Q$ where P and Q are function of y is :

A. $y(I.F) = \int (I.F)Qdx + c$

B. $x(IF) = \int (I.F)Pdy + c$

C. $x(I.F) = \int (I.F)Qdy + c$

D. $x(IF) = \int (I.F)Qdx + c$

Answer: C

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23. The degree of the differential equation $\frac{d^2y}{dx^2}x = \sqrt{y + \frac{dy}{dx}}$ is :

A. 0

B. 2

C. 1

D. 3

Answer: B

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24. If $y^2 = 4ax$ where a is constant then the differential equation formed is :

A. $y' = \frac{y}{2x}$

B. $y' = \frac{2y}{x}$

C. $y'' = 0$

D. $y' = \frac{x}{y}$

Answer: A

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25. The differential equation formed if $y = (A - Bx)e^{-2x}$ is :

A. $y'' + 4y = 0$

B. $y'' + 4y' + 4y = 0$

C. $y'' - 4y = 0$

D. $y'' - 4y' + 4y = 0$

Answer: B

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26. The differential equation that will represent the family of all circle having centre on the axis is and the radius units is :

A. $y(y' + 1)^2 = 1$

B. $y^2(y' + 1)^2 = 1$

C. $y^2\left(y'^2 + 1\right) = 1$

D. $yy' + y^2 = 0$

Answer: C

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27. Solve $(x^2 - y)dx + (y^2 - x)dy = 0$, if it passes through origin :

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

B. $x^3 + y^3 + 3xy = 0$

C. $x^2 + y^2 = 3xy$

D. $x^2 + y^2 + 3xy = 0$

Answer: A

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28. The differential equation representing the family of curve $y = A\sin(x + B)$ where A and B are parametres is :

A. $y'' - y = 0$

B. $\frac{d^2x}{dy^2} = 1$

C. $y'' = 0$

D. $y'' + y = 0$

Answer: D

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29. The order and degree of the differential equation $\sin^3 x(dx + dy) = \cos^3 x(dx - dy)$ is :

A. $(2, 2)$

B. $(2, 1)$

C. $(1, 2)$

D. $(1, 1)$

Answer: D

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30. The general solution of $\frac{dy}{dx} + \frac{y}{x} = 0$ is :

A. $y = kx$

B. $\log x = ky$

C. $xy = k$

D. $\log y = kx$

Answer: C

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31. If I.F of $\frac{dy}{dx} + P(x)y = Q(x)$ is $\cos^2 x$ then P (x) =

A. $-2\tan x$

B. $2\tan x$

C. $2\cot x$

D. $-2\cot x$

Answer: A

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32. The solution of $\frac{dy}{dx} + \frac{1}{x^2+1} = 0$ is

A. $y = \tan^{-1} x + c$

B. $y + \tan^{-1} x = c$

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

D. $x + \tan^{-1} y = c$

Answer: B

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33. The solution of $\frac{dy}{dx} = 2^{y-x}$ is

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

B. $3^x - 3^y = c$

C. $\frac{1}{3^x} - \frac{1}{3^y} = c$

D. $x + y = c$

Answer: C

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34. If $\sin^3 x$ is the integrating factor of the differential equation $\frac{dy}{dx} + Py = Q$:

A. $\tan^3 x$

B. $\cos t^3 x$

C. $3 \tan x$

D. $3 \cot x$

Answer: D

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35. The number of arbitrary constant in the particular solution of a differential equation of order 2 is :

A. 0

B. 1

C. 2

D. -1

Answer: A

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36. The slope at any point of the curve $y = f(x)$ is given by $\frac{dy}{dx} = 2x$ it passes through $(1, -1)$ then the equation of the curve is :

A. $y = x^2$

B. $y = x^2 - 2$

C. $y = x^2 + 1$

D. $y = x^2 + 2$

Answer: B

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37. The degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^2 = \sqrt{1+\left(\frac{dy}{dx}\right)}$ is :

A. 1

B. 2

C. 4

D. 6

Answer: C

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38. The solution of the differential equation $\frac{dy}{dx} + y = x$ is :

A. $e^{-x}(y - x + 1) = c$

B. $e^{-x}(x + y + 1) = c$

C. $e^{x}(y + x + 1) = c$

D. $e^{x}(y - x + 1) = c$

Answer: D

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Problems For Practice Answer The Following Questions

1. Find the order and degree of the following differential equation

$y'' = (2 + y')^{\frac{3}{4}}$

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2. Find the order and degree of the following differential equation

$(1 + y'')^2 = (y'')^2$

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3. Find the order and degree of the following differential equation

$$\rho = \frac{y''}{(1+y'^2)^{\frac{3}{2}}}$$

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4. Form the differential equation from the following

$$y = e^{-2x}(Ax + B)$$

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5. Form the differential equation from the following

$y = e^x(A\cos 2x + B\sin 2x)$

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6. Form the differential equation from the following

$y = e^{-2x}(Ax + B)$

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7. Find the diferential equation for the following

$y = e^{mx}$

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8. Find the differential equation for the following

$$y = e^{3x}(A\cos 2x + B\sin 2x)$$

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9. Solve

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

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10. Solve

$$x dy = \left(y + 4x^5 e^{x^4}\right) dx$$

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11. $\frac{dy}{dx} = e^{2x-y} + x^3 e^{-y}$

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12. $\cos^2 x dy + y e^{\tan x} dx = 0$

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13. Solve: $yx^2dx = e^{-x}dy$

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

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15. Solve : $\frac{dy}{dx} = (4x+y+1)^2$

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

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17. Solve the differential equation

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

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

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

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20. $dx+xdy=e^{-y}\sec^2 ydy$

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21. $\frac{dy}{dx}+2y\tan x=\sin x$

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

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