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Question No : 1 of 26 Marks: 1 (Budgeted Time 1 Min)

The solutions $y_1 = c_1$, $y_2 = c_2 \cos x$, $y_3 = c_3 \sin x$ of a Differential Equation are

Answer (Please select your correct option)

☒ Linearly independent

☐ Linearly dependent

☐ both of the other options

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60:00 Time Left

1

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Question No : 2 of 26 Marks: 1 (Budgeted Time 1 Min)

Wronskian of the functions $y_1(x) = 1$, $y_2(x) = \cos x$, $y_3(x) = \sin x$ is

Answer (Please select your correct option)

☐ 0

☒ 1

☐ 2

☐ 3

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2

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Question No : 3 of 26 Marks: 1 (Budgeted Time 1 Min)

The value of amplitude in the solution $X=7\sin(3t+2.45)$ is

Answer (Please select your correct option)

- ☒ 7
- ☐ 3
- ☐ 2.45
- ☐ 1

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3

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Question No : 4 of 26 Marks: 1 (Budgeted Time 1 Min)

The order of the differential equation $\left(\frac{du}{dt}\right)^{\frac{1}{3}} = \frac{1}{u}$ is

Answer (Please select your correct option)

☒ 1

☐ 2

☐ 3

☐ 4

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4

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Question No : 5 of 26 Marks: 1 (Budgeted Time 1 Min)

The solution of the differential equation $\frac{dy}{dx} = \tan x$ is -----

Answer (Please select your correct option)

☐ $y = \ln |\sin x| + c$

☐ $y = \ln |\sec x| + c$

☒ $y = \ln |\operatorname{cosec} x| + c$

☐ $y = \ln |\cos x| + c$

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5

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Question No : 6 of 26 Marks: 1 (Budgeted Time 1 Min)

A differential equation $M(x, y) dx + N(x, y) dy = 0$ is said to be an exact if -----.

Answer (Please select your correct option)

☐ $\frac{\partial M}{\partial x} = \frac{\partial N}{\partial y}$

☐ $\frac{\partial M}{\partial y} \neq \frac{\partial N}{\partial x}$

☒ $\frac{\partial M}{\partial y} = \frac{\partial N}{\partial x}$

☐ $\frac{\partial M}{\partial y} = \frac{\partial N}{\partial y}$

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6

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Question No : 7 of 26 Marks: 1 (Budgeted Time 1 Min)

The differential equation $(x^2 - 2x + 2y^2) dx + 2xy dy = 0$ is a/an ----- differential equation.

Answer (Please select your correct option)

- ☐ Exact
- ☒ Non-exact
- ☐ Homogenous
- ☐ Separable

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60:00 Time Left

7

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Question No : 8 of 26 Marks: 1 (Budgeted Time 1 Min)

For a 1st order linear differential equation $\frac{dy}{dt} - \frac{1}{t}y = 2t^2$, the integrating factor will be -----.

Answer (Please select your correct option)

☐ $\mu = -\frac{1}{t}$

☒ $\mu = \frac{1}{t}$

☐ $\mu = t$

☐ $\mu = 2t$

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60:00 Time Left

8

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Question No : 9 of 26 Marks: 1 (Budgeted Time 1 Min)

A differential equation $\frac{dy}{dx} + p(x)y = q(x)y^n$ for $n \neq 0, 1$ is called a/an ----.

Answer (Please select your correct option)

- ☐ Non-Exact differential equation
- ☐ Linear differential equation
- ☒ Bernoulli equation
- ☐ Exact differential equation

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60:00 Time Left

9

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Question No : 10 of 26 Marks: 1 (Budgeted Time 1 Min)

In order to change the Bernoulli Equation
 $\frac{dy}{dx} + p(x)y = q(x)y^x$
into linear differential equation, we choose ----.

Answer (Please select your correct option)

- ☐ $v = y^{x-1}$
- ☒ $v = y^{1-x}$
- ☐ $v = y^x$
- ☐ $v = y'$

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10

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Question No : 11 of 26 Marks: 1 (Budgeted Time 1 Min)

To convert the non-homogeneous differential equation $\frac{dy}{dx} = \frac{a_1x + b_1y + c_1}{a_2x + b_2y + c_2}$ into separable form, if $\frac{a_1}{a_2} = \frac{b_1}{b_2}$, then we use the substitution-----.

Answer (Please select your correct option)

☐ $x = X + h$

☐ $y = Y + h$

☒ $z = a_1x + b_1y$

☐ $z = Y + X$

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60:00 Time Left

11

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Question No : 12 of 26 Marks: 1 (Budgeted Time 1 Min)

In exponential model for the population growth $P(t) = P_0 e^{kt}$ if $k > 0$, then $\lim_{t \rightarrow \infty} P(t) = \dots$.

Answer (Please select your correct option)

☒ ∞

☐ $-\infty$

☐ 0

☐ 1

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60:00 Time Left

12

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Question No : 13 of 26 Marks: 1 (Budgeted Time 1 Min)

The constant solutions of the logistic equation $\frac{dP}{dt} = P(a - bP)$ are-----.

Answer (Please select your correct option)

- ☐ P=0, P= b/a
- ☒ P=0, P=a/b
- ☐ P=a/b, P=b/a
- ☐ P=0, P=0

Start Time: 5:28 AM
60:00 Time Left

13

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Question No : 14 of 26 Marks: 1 (Budgeted Time 1 Min)

The orthogonal trajectory to the family of curves $3x + 4y = c$ is-----.

Answer (Please select your correct option)

☐ $y = 2x$

☐ $y - x = c$

☒ $4x - 3y = c$

☐ $4x + 3y = c$

Start Time: 5:28 AM

60:00 Time Left

14

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Question No : 15 of 26 Marks: 1 (Budgeted Time 1 Min)

If the tangent lines of two curves are perpendicular at their point of intersection then both the curves are-----

Answer (Please select your correct option)

- ☐ Non-intersecting curves
- ☐ Parallel curves
- ☒ Orthogonal curves
- ☐ Intersecting curves

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60:00 Time Left

15

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Question No : 16 of 26 Marks: 1 (Budgeted Time 1 Min)

If initial amount of a radioactive isotope is 100g. What will be the amount at the end of 30 days such that $K=0.043$?

Answer (Please select your correct option)

☐ 371.415

☐ 380.560

☒ 363.279 The formula is $A(t)=A_0 e^{-kt} = 100(e^{-0.043 \times 30}) = 363.279$

☐ 360.351

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60:00 Time Left

16

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Question No : 17 of 26 Marks: 1 (Budgeted Time 1 Min)

If $y = 1 + 6x^2 - 7x^3$, then which of the following is true for it ?

Answer (Please select your correct option)

- ☐ Its annihilator operator is D .
- ☐ Its annihilator operator is D^2 .
- ☐ Its annihilator operator is D^3 .
- ☒ Its annihilator operator is D^4 .

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60:00 Time Left

17

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Question No : 18 of 26 Marks: 1 (Budgeted Time 1 Min)

If $y = e^{-6x}$, then which of the following is the most accurate option?

Answer (Please select your correct option)

- ☐ The annihilator operator of $y = e^{-6x}$ is $(D - 6)^2$.
- ☐ The annihilator operator of $y = e^{-6x}$ is $(D - 6)^3$.
- ☐ The annihilator operator of $y = e^{-6x}$ is $(D - 6)$.
- ☒ The annihilator operator of $y = e^{-6x}$ is $(D + 6)$.

Start Time: 5:28 AM

60:00 Time Left

18

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Question No : 19 of 26 Marks: 1 (Budgeted Time 1 Min)

If $y_1 = x$ and $y_2 = xe^x$ are the first and second solution of $x^2 \frac{d^2 y}{dx^2} - x(x+2) \frac{dy}{dx} + (x+2)y = 0$ on $(0, \infty)$, then which of the following is the most accurate option?

Answer (Please select your correct option)

- ☐ $y_1 = x$ and $y_2 = xe^x$ may or may not be linearly dependent.
- ☒ $y_1 = x$ and $y_2 = xe^x$ must be linearly independent.
- ☐ $y_1 = x$ and $y_2 = xe^x$ may or may not be linearly independent.
- ☐ $y_1 = x$ and $y_2 = xe^x$ must be linearly dependent.

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60:00 Time Left

19

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Question No : 20 of 26 Marks: 1 (Budgeted Time 1 Min)

If $y_2 = x^3$ is the second solution of $x^2 \frac{d^2 y}{dx^2} - x \frac{dy}{dx} - 3y = 0$, then which of the following is the most accurate option?

Answer (Please select your correct option)

- ☐ The first solution say y_1 must be non-trivial on the indicated interval.
- ☐ The first solution say y_1 can be trivial on the indicated interval. correct answer solve by hadi
- ☐ The first solution say y_1 must be discontinuous on the indicated interval.
- ☐ The first solution say y_1 may or may not be continuous on the indicated interval.

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60:00 Time Left

20

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Question No : 21 of 26 Marks: 2 (Budgeted Time 4 Min)

Find the order of the homogenous equation obtained from the following non-homogenous differential equation
 $y'' + 4y' + 3y = 4x^2 + 5$?

Answer (Please [click here](#) to Add Answer)

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60:00 Time Left

21

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Question No : 22 of 26 Marks: 2 (Budgeted Time 4 Min)

If half-time life (T) of a radioactive isotope is 5 days, then find k.

Answer (Please [click here](#) to Add Answer)

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60:00 Time Left

22

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Question No : 23 of 26 Marks: 3 (Budgeted Time 6 Min)

Determine the annihilator operator of the general solution of the following homogeneous linear first order differential equation:

$$\frac{dy}{dx} - 5y = 0$$

Answer (Please [click here](#) to Add Answer)

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60:00 Time Left

23

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Question No : 24 of 26 Marks: 3 (Budgeted Time 6 Min)

If $y_1(x) = e^x$ is the first solution of $\frac{d^2 y}{dx^2} + 2 \frac{dy}{dx} - 3y = 0$, then construct its second solution using $y_2(x) = y_1(x) \int \frac{e^{-\int P(x) dx}}{y_1^2(x)} dx$.

Note: where $P(x)$ is a coefficient of the first derivative involving in the above given differential equation.

Answer (Please [click here](#) to Add Answer)

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24

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Question No : 25 of 26 Marks: 5 (Budgeted Time 10 Min)

Find period of vibration of the solution of a simple harmonic motion?

Answer (Please [click here](#) to Add Answer)

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59:00 Time Left

25

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Question No : 26 of 26 Marks: 5 (Budgeted Time 10 Min)

Using Newton's Law of Cooling with initial condition $T(0)=T_0$ and if temperatures at time t_1 and t_2 are known then show that

$$\frac{T(t_1) - T_m}{T(t_2) - T_m} = e^{k(t_1 - t_2)}$$

Answer (Please click here to Add Answer)

If initial temperature of the cooling body is T_0 then we obtain the initial value problem

$$\frac{dT}{dt} = k(T - T_m), \quad T(0) = T_0$$

where k is constant of proportionality. The differential equation in the problem is linear as well as separable.

Separating the variables and integrating we obtain

$$\int \frac{dT}{T - T_m} = \int k dt$$

This means that

$$\ln |T - T_m| = kt + C$$

$$T - T_m = e^{kt+C}$$

$$T(t) = T_m + C_1 e^{kt} \text{ where } C_1 = e^C$$

Now applying the initial condition $T(0) = T_0$, we see that $C_1 = T_0 - T_m$. Thus the solution of the initial value problem is given by

$$T(t) = T_m + (T_0 - T_m)e^{kt}$$

Hence, If temperatures at times t_1 and t_2 are known then we have

$$T(t_1) - T_m = (T_0 - T_m)e^{kt_1}, \quad T(t_2) - T_m = (T_0 - T_m)e^{kt_2}$$

So that we can write

$$\frac{T(t_1) - T_m}{T(t_2) - T_m} = e^{k(t_1 - t_2)}$$

Start Time: 5:28 AM

59:00 Time Left

26

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