

First Order & First Degree ODE - II

Detailed Course on Differential Equation for IIT JAM' 23 - II



Gajendra Purohit

Legend in CSIR-UGC NET & IIT-JAM

- Unlock Code : GPSIR ~ PhD, CSIR NET (Maths) | Youtuber(800K+165K Sub.)/Dr.Gajendra Purohit (Maths), 17+ Yr. Experience, Author

50M Watch mins

3M Watch mins (last 30 days)

44K Followers

2K Dedications

→ **TOP EDUCATOR ON UNACADEMY
FOR CSIR NET & IIT JAM**

YouTuber with 800K Subscribers

→ **AUTHOR OF BEST SELLER BOOK
FOR CSIR NET & IIT JAM**

**Get
10% Off**

Referral Code : GP SIR



CRACK IIT JAM IN FIRST ATTEMPT

Total applicants last 3 years

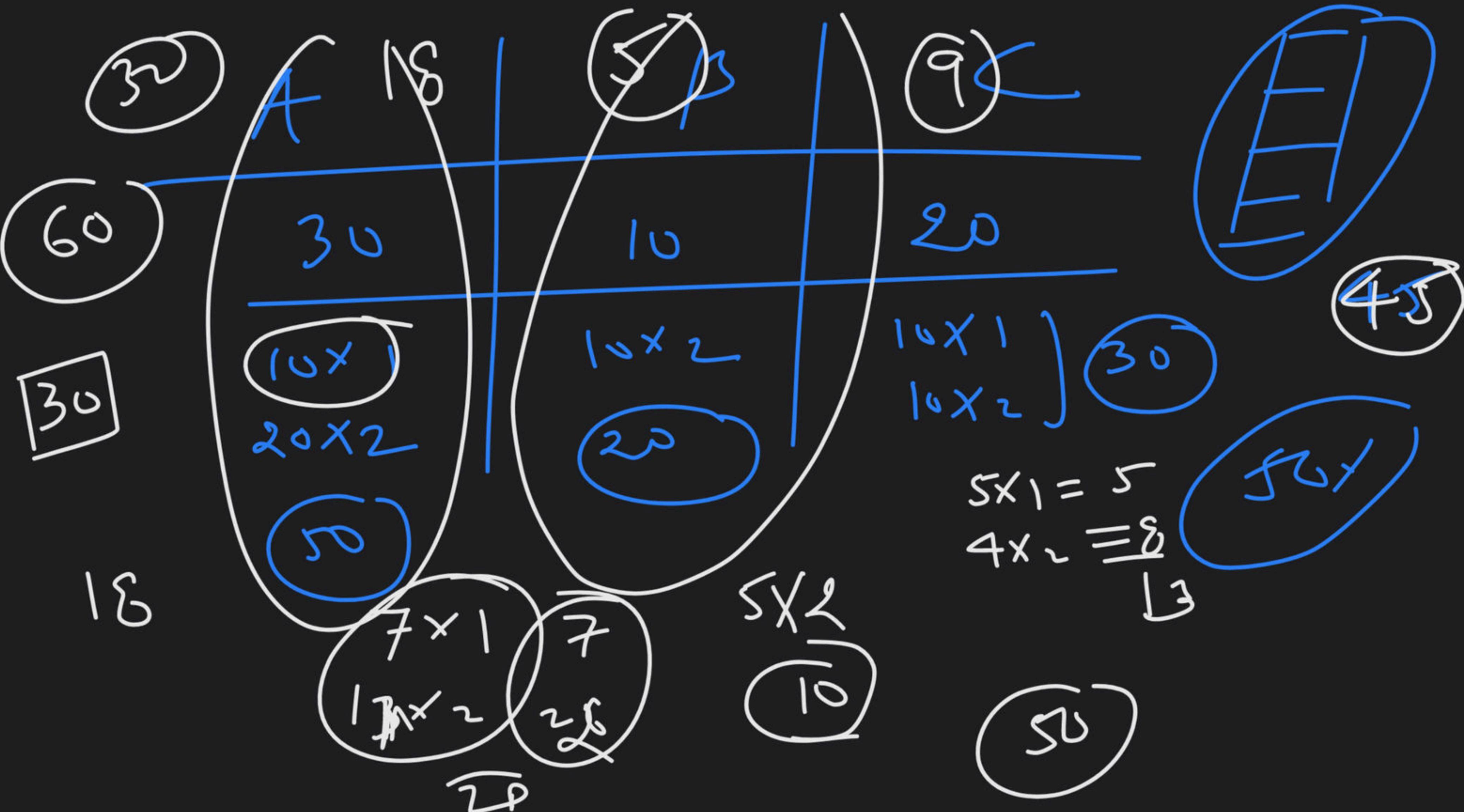
Approx. 12000 to 14000

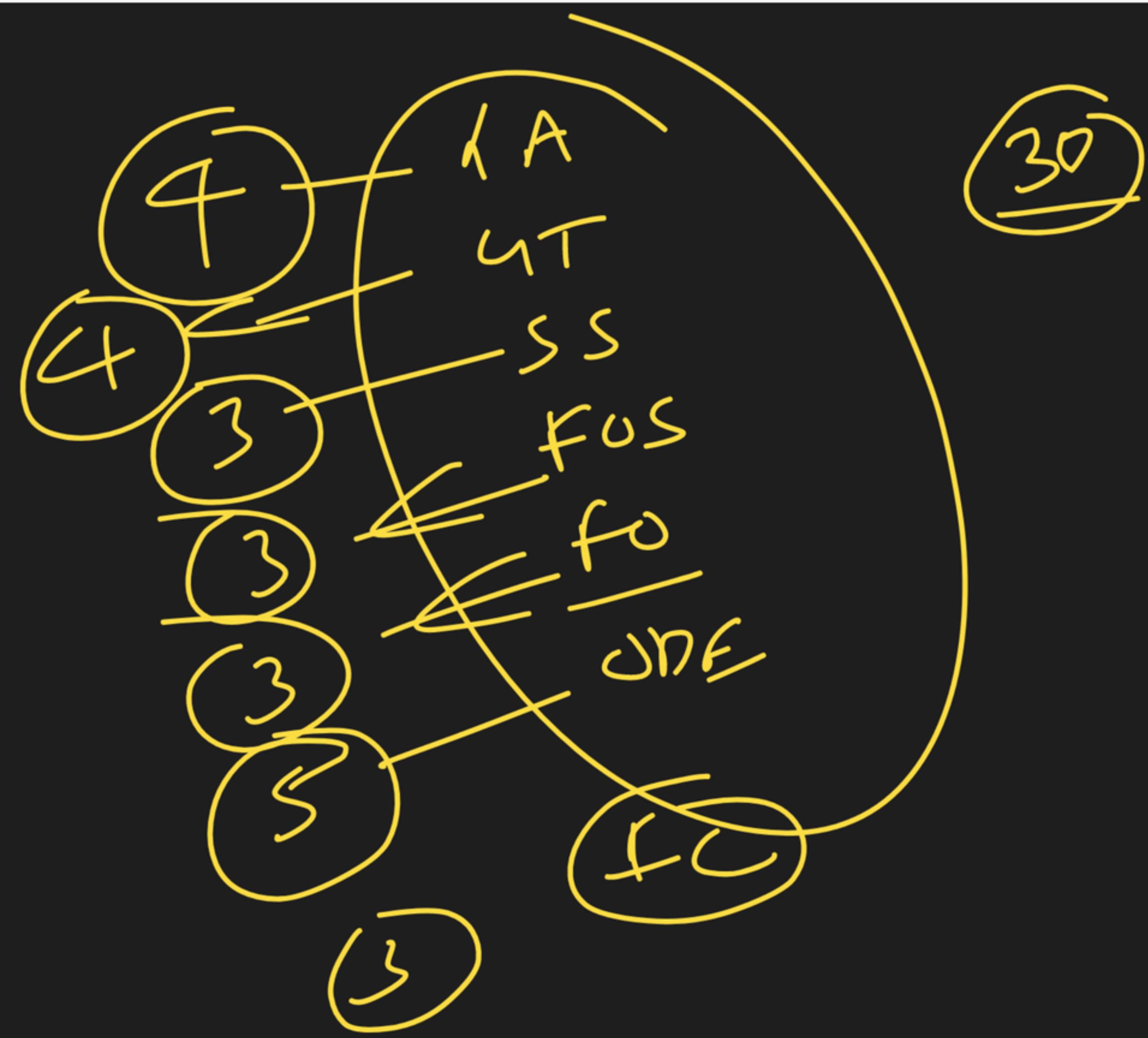
EXAM PATTERN

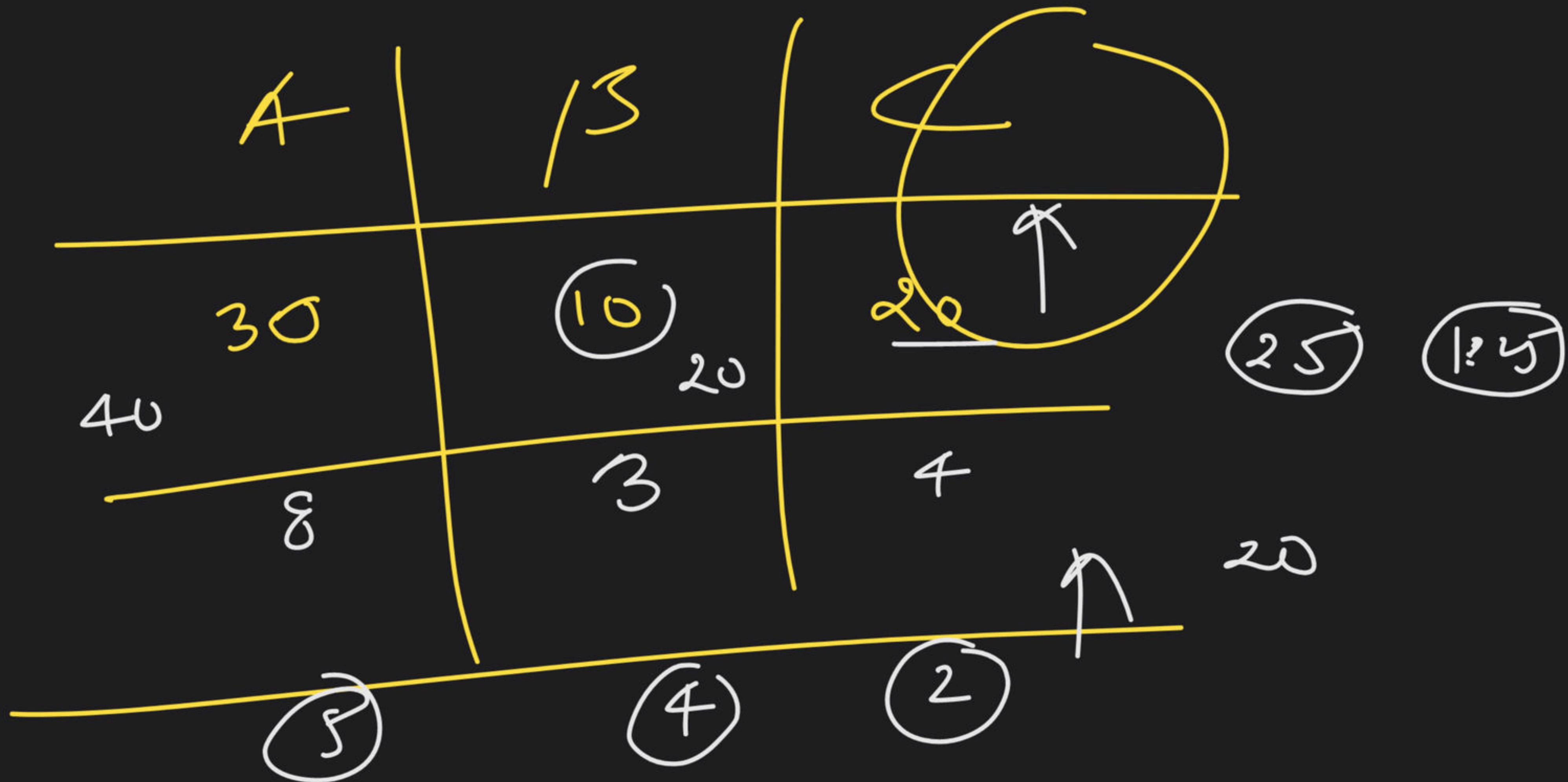
MARKS DISTRIBUTION

SECTION-A:-MCQ	MARKS	NEGATIVE MARKS
	Total 30 Questions	
SECTION-A:-MCQ	10 questions x 1 marks each = 10 marks 20 questions x 2 marks each = 40 marks	1/3rd for 1 mark question 2/3rd for 2 mark question
	Total 10 Questions	
SECTION-B:-MSQ	2 marks each $10 \times 2 = 20$ marks	No negative marking No partial marking
	Total 20 Questions	
SECTION-C:-CAT	10 questions x 1 marks each = 10 marks 10 questions x 2 marks each = 20 marks	No negative marking No partial marking

Total Marks - 100



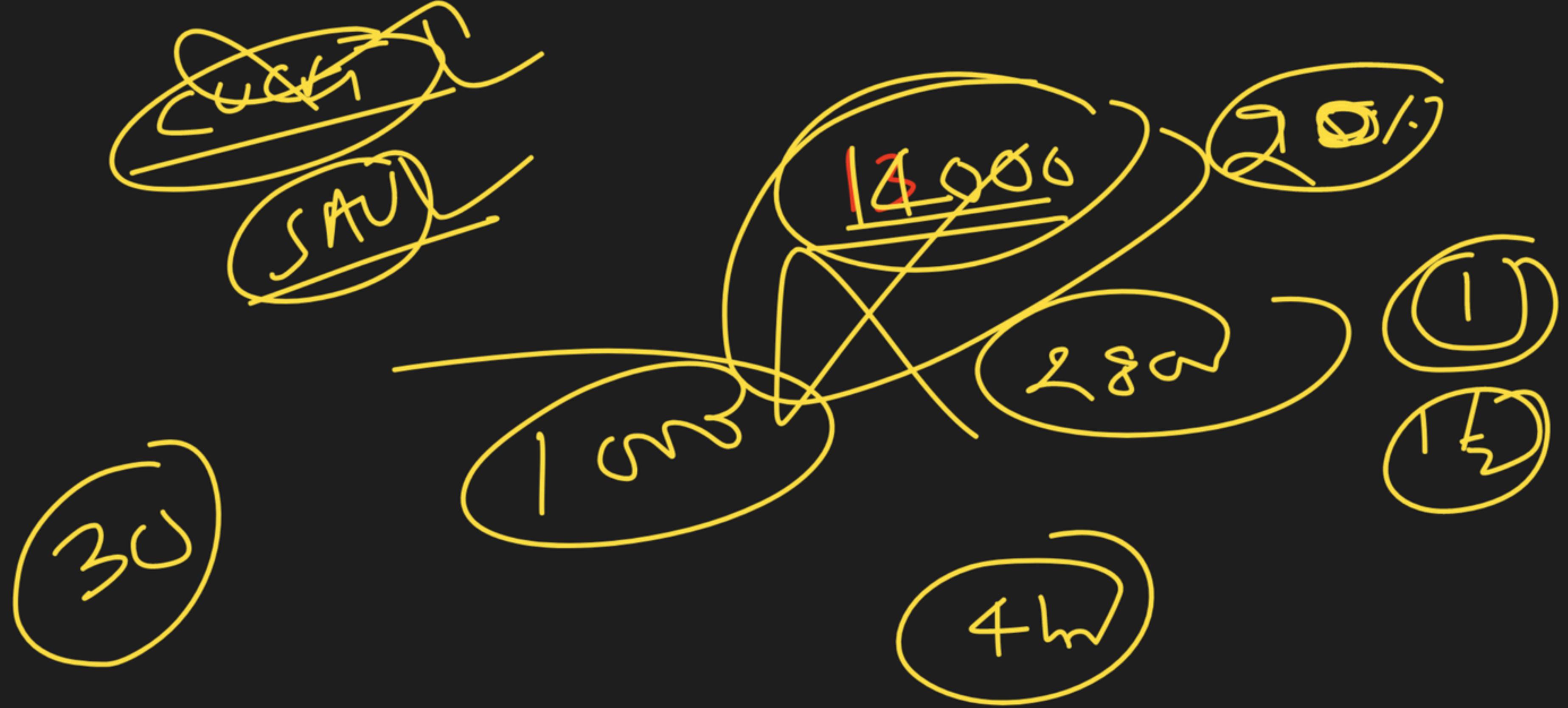




IIT JAM LAST 3 YEAR CUT OFFs

MATHEMATICS

Test Paper(s)	Number of Appeared Candidates	IIT JAM Cutoffs Marks		
		Gen.	OBC (NCL) EWS	SC/ST Pwd
2021	13186	24.69	22.22	12.35
2020	14374	33.65	30.29	16.82
2019	12863	22.96	20.66	11.48



PREPARATION STRATEGY

SUBJECT	LAST 3 YEARS AVERAGE MARKS
Real Analysis	21 Marks
Abstract Algebra	10 Marks
Calculus of Single Variable	18 Marks
Calculus of Two-Variable	14 Marks
Vector Calculus	14 Marks
Differential Equation	11 Marks

STRATEGY

PART A	PART B	PART C
$5 \times 1 = 5$ marks		$5 \times 1 = 5$ marks
$8 \times 2 = 16$ marks	$4 \times 2 = 8$ marks	$4 \times 2 = 8$ marks
Total = 21 Marks	Total = 8 Marks	Total = 13 Marks
Total = 21+8+13 = 42		

IIT JAM

How to Prepare?

When to Start?



NEW COURSE for IIT JAM 2022

**Use Code: GPSIR
To Unlock**

GAJENDRA PUROHIT

ALERT!

IIT JAM Subscription
PRICE HIKE SOON!!

HURRY

BEAT THE PRICE HIKE AND

Enroll Now





CSIR

We heard you and upgraded the
Ask a Doubt feature to suit your needs!

Unacademy Ask a Doubt



The Ask a Doubt feature is now available on the Website and the Learner App . Getting your doubts clarified is easier and faster than before!

ASK A DOUBT



RANK BOOSTER COURSE UNIT 3 CSIR NET 2022

1st AUGUST

Gajendra Purohit

Enroll Now

USE CODE
GPSIR
FOR 10% OFF





DETAILED COURSE 2.0 DIFFERENTIAL EQUATION

4th AUGUST

Gajendra Purohit

Enroll Now

USE CODE
GPSIR
FOR 10% OFF



Introducing UA Lite for CSIR-UGC NET

1 month subscription at ₹1,500
2 month subscription at ₹2,100

Get access to :

- Curated Test Series
- Question Bank
- Exams of Previous Year Question Papers

Subscribe Now

Use code - GPSIR



FEE DETAILS FOR IIT JAM SUBSCRIPTION

No cost EMI available on 6 months & above subscription plans

24 months ₹ 908 / mo
Save 67%
Total ₹ 21,780

You get 6 months extra for free Offer expires 15 Jun 2022

✓ 12 months ₹ 1,248 / mo
Save 54%
Total ₹ 14,974

You get 6 months extra for free Offer expires 15 Jun 2022

9 months ₹ 1,497 / mo
Save 45%
Total ₹ 13,475

6 months ₹ 2,042 / mo
Save 25%
Total ₹ 12,252

3 months ₹ 2,269 / mo
Save 17%
Total ₹ 6,807

1 month ₹ 2,723 / mo
Save 0%
Total ₹ 2,723

To be paid as a one-time payment

Have a referral code?

Proceed to pay

No cost EMI available on 6 months & above subscription plans

24 months ₹ 817 / mo
Save 67%
Total ₹ 21,700 ₹ 19,602

You get 6 months extra for free Offer expires 15 Jun 2022

✓ 12 months ₹ 1,123 / mo
Save 54%
Total ₹ 13,477

You get 6 months extra for free Offer expires 15 Jun 2022

9 months ₹ 1,348 / mo
Save 45%
Total ₹ 12,128

6 months ₹ 1,838 / mo
Save 25%
Total ₹ 11,027

3 months ₹ 2,042 / mo
Save 17%
Total ₹ 6,126



After Using
My Referral
Code



GPSIR

Awesome! You get 10% off

Proceed to pay

1. **Linear differential equation** : A differential equation is called linear if

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

$$y \left(\frac{dy}{dx} \right)$$

$$\frac{dy}{dx}$$

$$y$$

(i) All derivative and dependent variable is of degree one.

(ii) There is no product of derivative and dependent variable.

$$\left(\frac{dy}{dx} \right)^l + (n+1) \frac{dy}{dx} + g = 0$$

2. **Non-linear differential equation** : A differential equation which is not linear is called non-linear differential equation.

$$\left(\frac{dy}{dx} \right)^2 + g = 0$$

Note: A differentiable equation is non - linear if it contain $\sin y$, $\cos y$, e^y etc. where y is dependent variable

$$y \frac{dy}{dx} + v = b$$

Q1. The differential equation $\frac{d^2y}{dx^2} + \frac{dy}{dx} + \sin y = 0$ is

- (a) linear
- (b) nonlinear
- (c) Order 3
- (d) of degree 2

Q2. The differential equation $\frac{d^2y}{dx^2} + (x^2 + 4x)\frac{dy}{dx} + y = x^8 - 8$

is

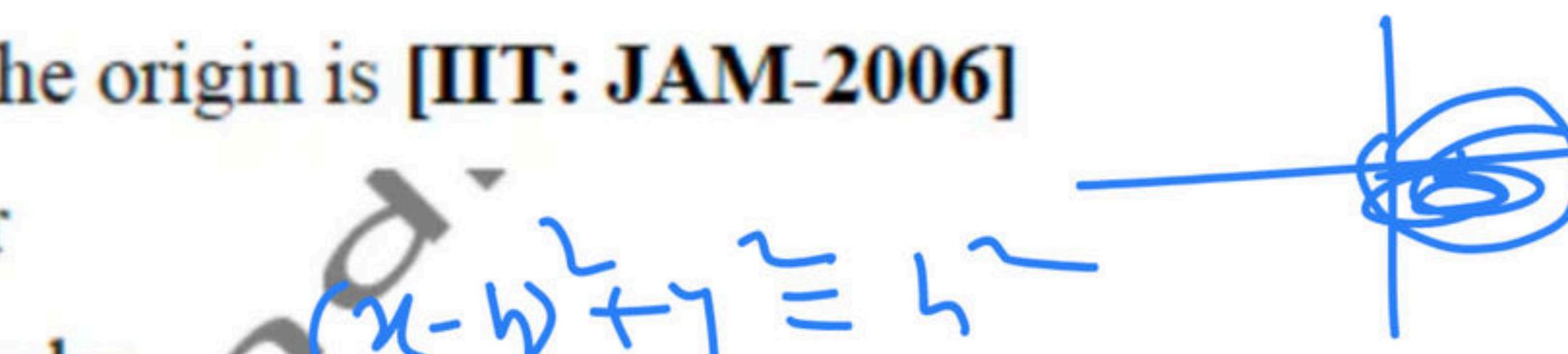
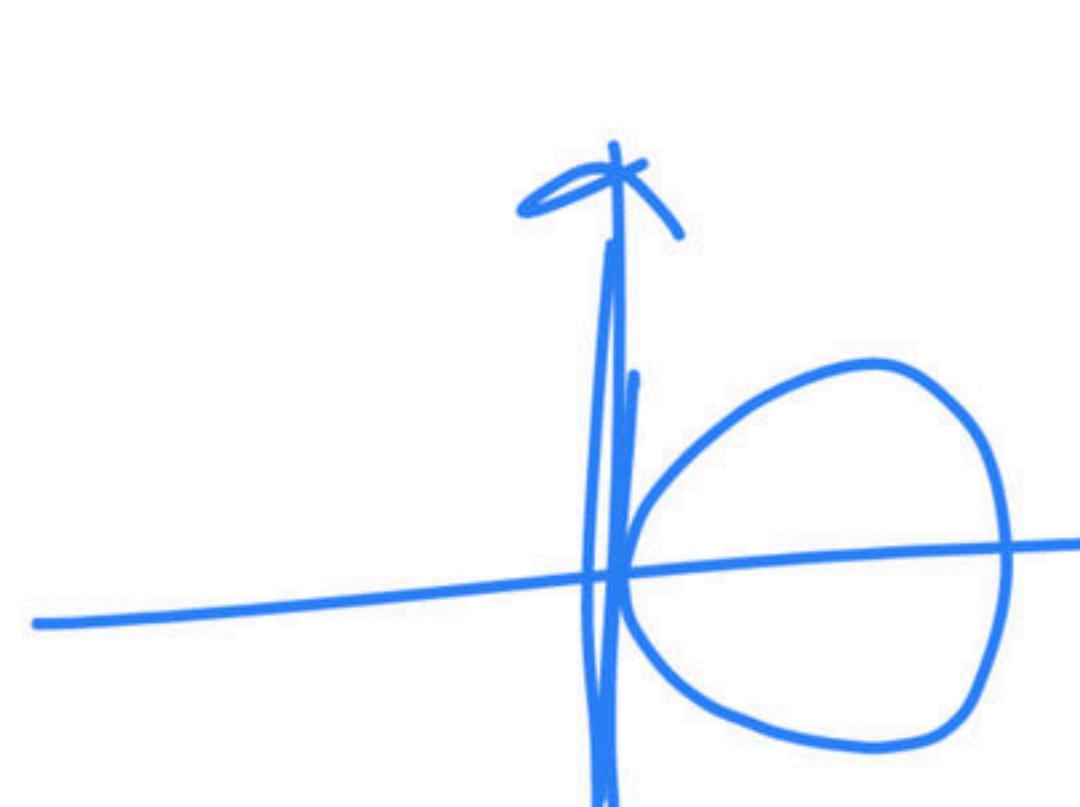
- (a) Partial differential equation
- (b) nonlinear
- (c) second order linear
- (d) linear

- a
- b
- c
- d

a, b
b, c
c, d
a, d

Q3. The differential equation representing the family of circles touching y-axis at the origin is [IIT: JAM-2006]

- (a) Linear and of first order
- (b) Linear and of second order
- (c) Nonlinear and of first order
- (d) Nonlinear and of second order


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


~~Solution of DE : Let $f(x, y, y', \dots, y^{(n)})$ be the n^{th} order~~

~~linear differential equation then $\phi(x)$ is the solution of the
DE if~~

- (i) $\phi, \phi', \dots, \phi^{(n)}$ exists.
- (ii) $\phi(x)$ satisfy the DE i.e. $f(x, \phi, \phi', \phi'', \dots, \phi^{(n)}) = 0$

$$y'(n) = x_1|n|$$

$$y'(x_1) = n|n| = \begin{cases} -n^2 & n < 0 \\ n^2 & n > 0 \end{cases}$$

(1)

$$y' - 2|x_1| = 0$$

$$y'(x_1) = 2|y_1| = \begin{cases} -2n & n < 0 \\ 2n & n > 0 \end{cases}$$

$$\begin{aligned} & y'(x_1) = -2 \\ & y(x_1) = -2x_1 + C \\ & y(x_1) = 2x_1 + C \end{aligned}$$

Q.4. Let $y(x)$ be the solution of DE $y' = y^2 + t$, then

- (a) y is thrice differentiable but 3rd order does not exist.
- (b) y is thrice differentiable but higher order derivative does not exist.
- (c) y is infinite time differentiable.
- (d) None of these

General Solution : A solution of DE in which number of arbitrary constant is equal to the order of DE is called general solution.

Particular Solution : A solution of the DE obtain from general solution by taking some particular value of arbitrary constant is called particular solution (there are always infinite particular solution).

$$\frac{d^2y}{dx^2} - 1 = 0$$
$$y = C_1 e^x + C_2 e^{-x}$$

$$\frac{d^2y}{dx^2} - 1 = 0$$
$$y = C_1 e^x + C_2$$

TARGETED AUDIENCE

- IIT-JAM
- M.Sc. Entrance Exam

COMPLETE COURSE ON

MATHEMATICS

FOR IIT-JAM 2022

TOPICS TO BE COVERED

- REAL ANALYSIS
- FUNCTION OF ONE & TWO VARIABLE
- LINEAR ALGEBRA
- MODERN ALGEBRA

TOPICS TO BE COVERED

- SEQUENCE & SERIES
- INTEGRAL CALCULUS
- VECTOR CALCULUS
- DIFFERENTIAL EQUATION

FEE DETAILS FOR IIT JAM SUBSCRIPTION

No cost EMI available on 6 months & above subscription plans

24 months ₹ 908 / mo
Save 67%
Total ₹ 21,780

You get 6 months extra for free Offer expires 15 Jun 2022

✓ 12 months ₹ 1,248 / mo
Save 54%
Total ₹ 14,974

You get 6 months extra for free Offer expires 15 Jun 2022

9 months ₹ 1,497 / mo
Save 45%
Total ₹ 13,475

6 months ₹ 2,042 / mo
Save 25%
Total ₹ 12,252

3 months ₹ 2,269 / mo
Save 17%
Total ₹ 6,807

1 month ₹ 2,723 / mo
Save 0%
Total ₹ 2,723

To be paid as a one-time payment

Have a referral code?

Proceed to pay

No cost EMI available on 6 months & above subscription plans

24 months ₹ 817 / mo
Save 67%
Total ₹ 21,700 ₹ 19,602

You get 6 months extra for free Offer expires 15 Jun 2022

✓ 12 months ₹ 1,123 / mo
Save 54%
Total ₹ 13,477

You get 6 months extra for free Offer expires 15 Jun 2022

9 months ₹ 1,348 / mo
Save 45%
Total ₹ 12,128

6 months ₹ 1,838 / mo
Save 25%
Total ₹ 11,027

3 months ₹ 2,042 / mo
Save 17%
Total ₹ 6,126



**After Using
My Referral
Code**



GPSIR

Awesome! You get 10% off

Proceed to pay

FOUNDATION COURSE OF

MATHEMATICS

FOR CSIR-NET

~~Singular Solution~~ : A solution of DE which is neither general solution nor is particular solution is called singular solution.

Q.6. The number of arbitrary constant in the complete primitive of the differential equation

$$\phi(x, y, dy/dx, d^5y/dx^5)$$

- (a) 1
- (b) 2
- (c) 5
- (d) 4

$$(y')^2 = 4y, \quad y(0) = 1$$

$$y' = 2\sqrt{y}$$

$$\frac{dy}{\sqrt{y}} = 2dx$$

$$\int \frac{dy}{\sqrt{y}} = \int 2dx$$

G.S.

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

$$y = e^{2x+C}$$

$$2\sqrt{y} = 2x + C$$

$$\sqrt{y} = x + C'$$

$$y = 0$$

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

$$y = Ce^x + Ce^0$$

$$y = 2e^x + Ce^x$$

$$y = (C_1 + C_2)x$$

$$y = (C_1 + C_2)x$$

P.S.

Q.7. If $f(x)$ and $g(x)$ are two solutions of the

differential equation $\left(a \frac{d^2y}{dx^2} + x^2 \frac{dy}{dx} + y = e^x \right)$,

$a \frac{d^2f}{dx^2} + x^2 \frac{df}{dx} + f = e^x$

(1)

then $f(x) - g(x)$ is the solution of :

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

$a \frac{d^2g}{dx^2} + x^2 \frac{dg}{dx} + g = e^x$

(2)

(b) $a^2 \frac{d^2y}{dx^2} + y = 0$

(1) (2)

(c) ~~$a^2 \frac{d^2y}{dx^2} + x^2 \frac{dy}{dx} + y = 0$~~

$a \frac{d^2(f-g)}{dx^2} + x^2 \frac{d(f-g)}{dx} + (f-g) = 0$

(d) $a \frac{d^2y}{dx^2} + y = 0$

$a \frac{d^2\gamma}{dx^2} + x^2 \frac{d\gamma}{dx} + \gamma = 0$

Methods of solving differential equation

Variable separable method

The equation of this type can be put in the form

$$\underline{f(x)dx + g(y)dy = 0}$$

Integrating both sides, we get the solution

$$\underline{\int f(x)dx + \int g(y)dy = C}$$

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

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

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

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

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

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

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

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

$$\text{Integrating } (e^x + y^3) dx + C$$

Equation Reducible into Separable Form

If $\frac{dy}{dx} = f(ax + by + c)$, then substitute $u = ax + by + c$ and

corresponding reduced differential equation is

$a + bf(u) = \frac{du}{dx}$ and solution is given by

$$\int \frac{du}{a + bf(u)} = \int dx + c$$

Q.8. The solution of $\frac{dy}{dx} - y^2 = 1$ satisfying the condition

$y(0) = 1$ is

(a) $y = e^{x^2}$

(b) $y = \sqrt{x}$

(c) $y = \cot\left(x + \frac{\pi}{4}\right)$

(d) $y = \tan\left(x + \frac{\pi}{4}\right)$

$$\tan^{-1} y = x + \frac{\pi}{4}$$

$$y = \tan\left(x + \frac{\pi}{4}\right)$$

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

$$\int \frac{dy}{1+y^2} = \int dx + C$$

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

$$\tan^{-1} 1 = C$$

$$C = \frac{\pi}{4}$$

7 Aug.
Q9. If y is the solution of the differential equation

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

(a) -2

(c) 0

$$y^3 dy + y^3 dx = 0$$

$$\frac{y^4}{4} + \frac{x^4}{4} = C$$

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

$$0 + 1 = 4C$$

$$= y^4$$

(b) -1

(d) 1

$$y^4 + (-1)^4$$

$$(-1)^4 + 1^4 = 1$$

$$1 + 1^4 = 1$$

$$y = 0$$

Q. 9. Match each differential equation in Group I to its family solution curves from Group II

Group I

A. $\frac{dy}{dx} = \frac{y}{x}$

B. $\frac{dy}{dx} = -\frac{y}{x}$

C. $\frac{dy}{dx} = \frac{x}{y}$

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

Group II

1. Circles

2. Straight lines

3. Hyperbola

- (a) A-2 ,B-3 ,C-3 ,D-1
- (b) A-1 ,B-3 ,C-2 ,D-1
- (c) A-2 ,B-1 ,C-3 ,D-3
- (d) A-3 ,B-2 ,C-1 ,D-2

Q10. Let $y(x)$ be the solution of the differential equation

$$\frac{d}{dx} \left(x \frac{dy}{dx} \right) = x; \quad y(1) = 0, \quad \left. \frac{dy}{dx} \right|_{x=1} = 0. \text{ Then } y(2) \text{ is}$$

[IIT-JAM: 2016]

(a) $\frac{3}{4} + \frac{1}{2} \ln 2$

(b) $\frac{3}{4} - \frac{1}{2} \ln 2$

(c) $\frac{3}{4} + \ln 2$

(d) $\frac{3}{4} - \ln 2$



CSIR

We heard you and upgraded the
Ask a Doubt feature to suit your needs!

Unacademy Ask a Doubt



The Ask a Doubt feature is now available on the Website and the Learner App . Getting your doubts clarified is easier and faster than before!

ASK A DOUBT



RANK BOOSTER COURSE UNIT 3 CSIR NET 2022

1st AUGUST

Gajendra Purohit

Enroll Now

USE CODE
GPSIR
FOR 10% OFF





DETAILED COURSE 2.0 DIFFERENTIAL EQUATION

4th AUGUST

Gajendra Purohit

Enroll Now

USE CODE
GPSIR
FOR 10% OFF



Introducing UA Lite for CSIR-UGC NET

1 month subscription at ₹1,500
2 month subscription at ₹2,100

Get access to :

- Curated Test Series
- Question Bank
- Exams of Previous Year Question Papers

Subscribe Now

Use code - GPSIR



Educator Profile



Gajendra Purohit

#5 Educator in CSIR-UGC NET

[Follow](#)

Dr.Gajendra Purohit PhD, CSIR NET (Maths) | Youtuber(330K+30k Sub.)/Dr.Gajendra Purohit (Maths), 17+ Yr. Experience, Author of Bestseller

11M Watch mins

1M Watch mins (last 30 days)

22k Followers

1k Dedications



CSIR-UGC NET

[SEE ALL](#)

HINDI MATHEMATICAL SCIENCES
Course on Linear Algebra, Partial Diff. Equation & Calculus
Starts on Mar 1, 2021 • 24 lessons
Gajendra Purohit

HINDI MATHEMATICAL SCIENCES
Course on Complex Analysis & Integral Equation
Starts on Jan 14, 2021 • 16 lessons
Gajendra Purohit

HINDI MATHEMATICAL SCIENCES
Foundation Course on Mathematics for CSIR 2021
Starts on Dec 7, 2020 • 20 lessons
Gajendra Purohit

Educator highlights

- 📍 Works at Pacific Science College
- 📍 Studied at M.Sc., NET, PhD(Algebra), MBA(Finance), BEd
- 📍 PhD, NET | Plus Educator For CSIR NET | Youtuber (260K+Subs.) | Director Pacific Science College |
- 📍 Lives in Udaipur, Rajasthan, India
- 📍 Unacademy Educator since

FEE DETAILS FOR IIT JAM SUBSCRIPTION

No cost EMI available on 6 months & above subscription plans

24 months ₹ 908 / mo
Save 67%
Total ₹ 21,780

You get 6 months extra for free Offer expires 15 Jun 2022

✓ 12 months ₹ 1,248 / mo
Save 54%
Total ₹ 14,974

You get 6 months extra for free Offer expires 15 Jun 2022

9 months ₹ 1,497 / mo
Save 45%
Total ₹ 13,475

6 months ₹ 2,042 / mo
Save 25%
Total ₹ 12,252

3 months ₹ 2,269 / mo
Save 17%
Total ₹ 6,807

1 month ₹ 2,723 / mo
Save 0%
Total ₹ 2,723

To be paid as a one-time payment

Have a referral code?

Proceed to pay

No cost EMI available on 6 months & above subscription plans

24 months ₹ 817 / mo
Save 67%
Total ₹ 21,700 ₹ 19,602

You get 6 months extra for free Offer expires 15 Jun 2022

✓ 12 months ₹ 1,123 / mo
Save 54%
Total ₹ 13,477

You get 6 months extra for free Offer expires 15 Jun 2022

9 months ₹ 1,348 / mo
Save 45%
Total ₹ 12,128

6 months ₹ 1,838 / mo
Save 25%
Total ₹ 11,027

3 months ₹ 2,042 / mo
Save 17%
Total ₹ 6,126



After Using
My Referral
Code



GPSIR

Awesome! You get 10% off

Proceed to pay

THANK YOU VERY MUCH EVERYONE

GET THE UNACADEMY PLUS SUBSCRIPTION SOON.

TO GET 10% DISCOUNT IN TOTAL SUBSCRIPTION AMOUNT

USE REFERRAL CODE: GPSIR