Online Examinations (Even Sem/Part-I/Part-II Examinations 2020 - 2021

Course Name - –Mathematical Modelling
Course Code - MSCME402

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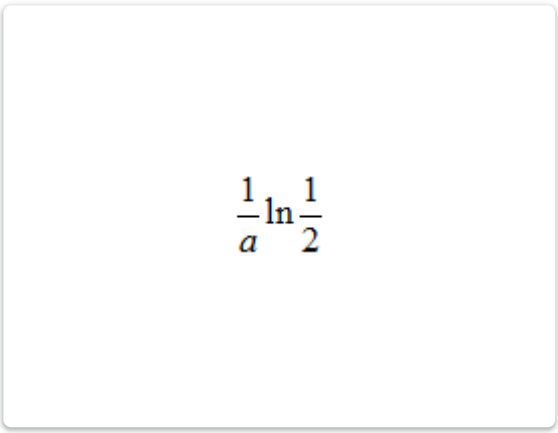
Answer all the questions. Each question carry one mark.

9. 1. In population growth model, if a>0 (i.e., birth rate – death rate >0), then the population will become double its present size at time

Mark only one oval.



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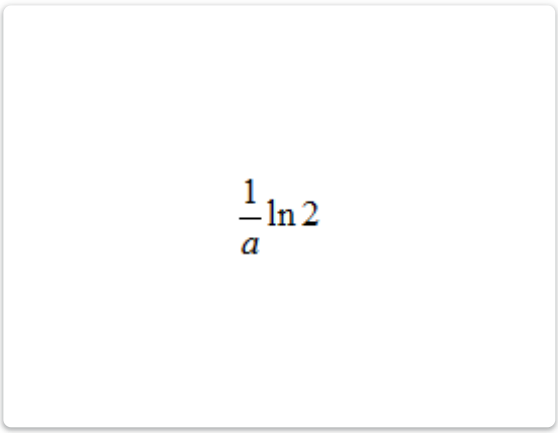

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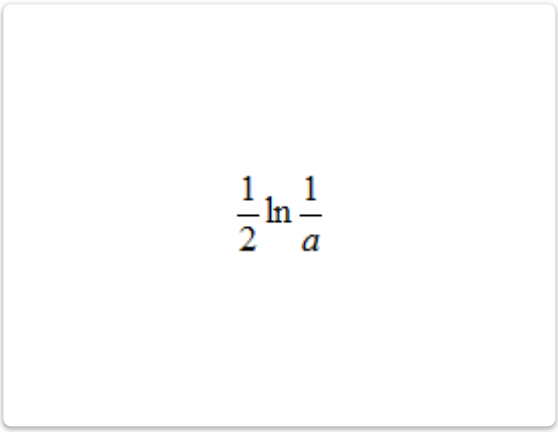

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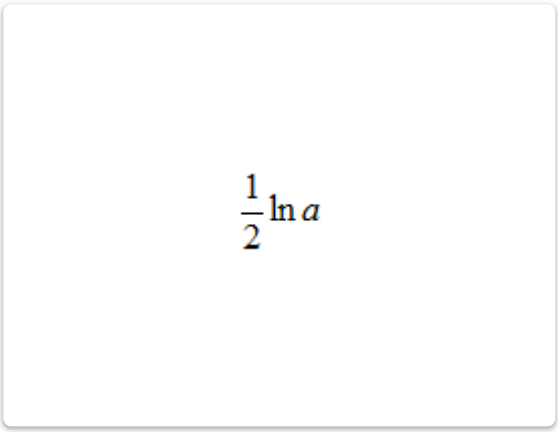


Option 4

10. 2. Let x (t) is the population size at time t. If the birth rate is equal to the death rate, then the population size

Mark only one oval.

- grows exponentially
- decays exponentially
- remains constant
- None of these

11. 3.

In xy-plane, the curve passing through (0,3) point and having the tangent of slope $2x/y^2$ at any point (x, y) is

Mark only one oval.

$\frac{1}{3}y^3 = x^2 + C$

Option 1

$\frac{1}{9}y^3 = x^2 + 9$

Option 2

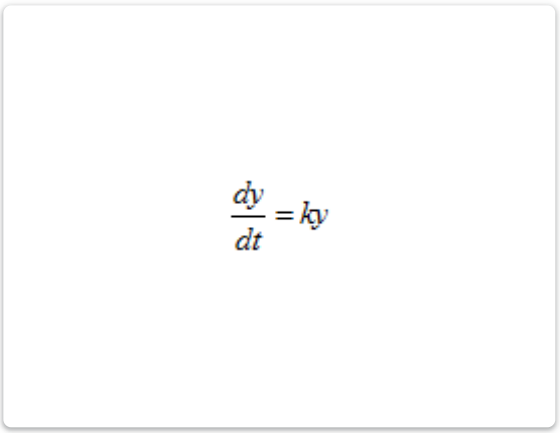
$\frac{1}{3}y^3 = x^2 + 9$

Option 3

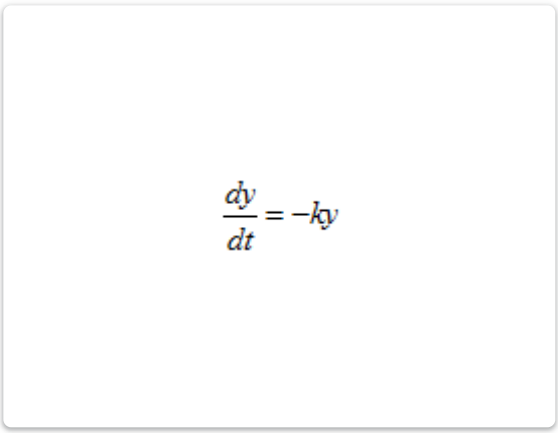
None of these

12. 4. Suppose that a quantity y = y(t) has an exponential growth model with growth constant k > 0. Then y(t) satisfies a first-order differential equation of the form

Mark only one oval.



Option 1



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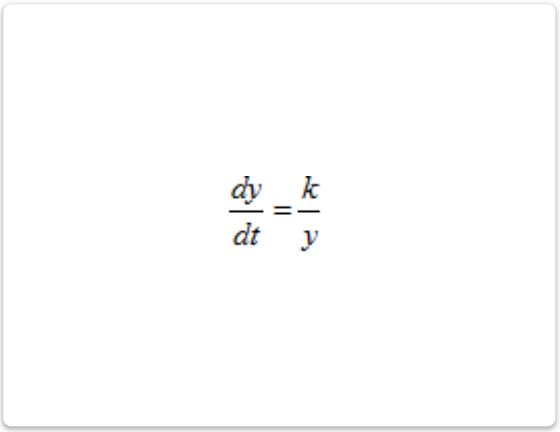


Option 3

None of these

13. 5. Suppose that the half-life of a radioactive element is 1 minute. If 32 g of the element are available in a container at 1:00 p.m., then the amount remaining at 1:05 p.m. will be

Mark only one oval.

6.4 g

4 g

2 g

1 g

14. 6. A colony of fruit flies is growing exponentially at a rate of 2% per day. If the initial size of the colony is 100 fruit flies, then after t days the size of the colony will be

Mark only one oval.

$y(t)=10e^{0.2}$

Option 1

$y(t)=100e^{0.02}$

Option 2

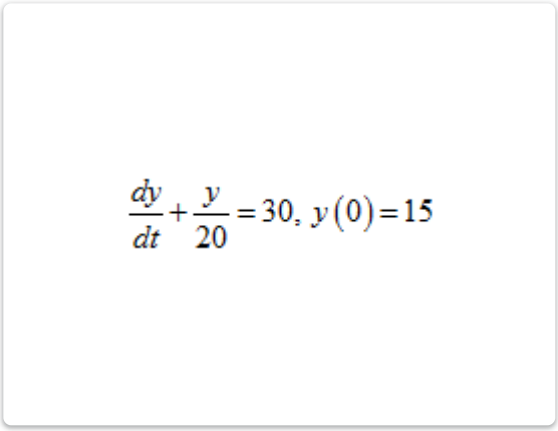
$y(t)=100e^{0.2}$

Option 3

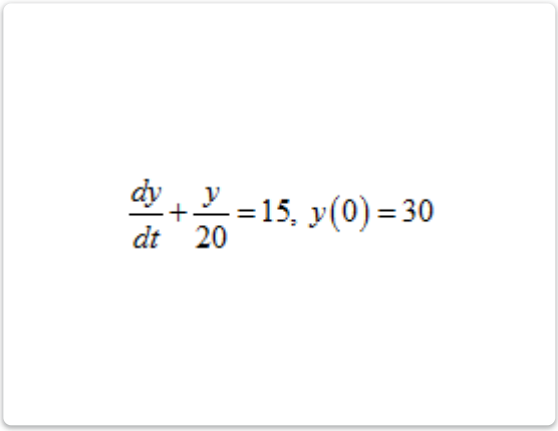
None of these

15. 7. At time t = 0, a tank contains 30 oz of salt dissolved in 60 gal of water. Then brine containing 5 oz of salt per gallon of brine is allowed to enter the tank at a rate of 3 gal/min and the mixed solution is drained from the tank at the same rate. Give an initial-value problem satisfied by the amount of salt y(t) in the tank at time t .

Mark only one oval.



Option 1



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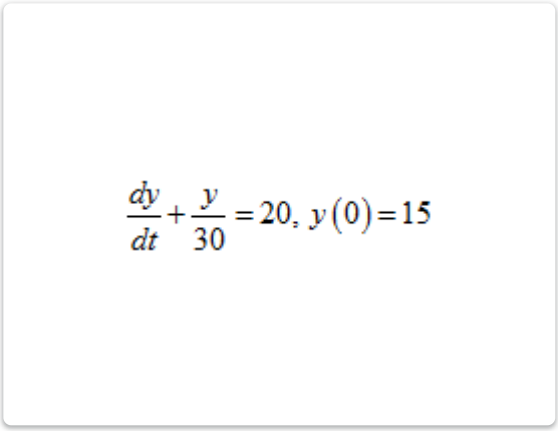

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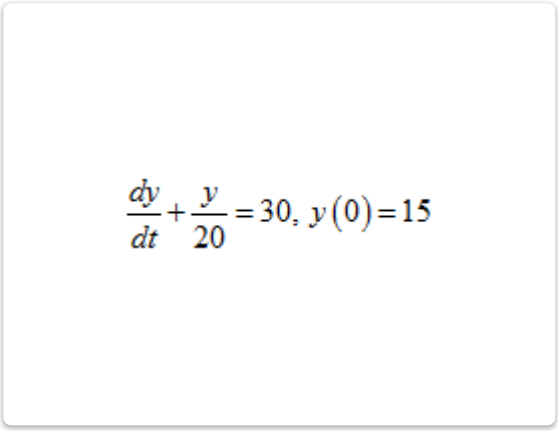


Option 4

16. 8. Mathematical models provide

Mark only one oval.

- estimated results
- accurate results
- wrong results
- approximate results

17. 9. Mathematical models allow us to calculate

Mark only one oval.

- different quantities
- area only
- speed only
- distance and time

18. 10. Regarding the technique of mathematical modeling, which of the following is the correct order, if P: Mathematical problem Q: Real problem R: Interpretation S: Mathematical Solution

Mark only one oval.

- PQRSP
- QPRSQ
- SPRQS
- QPSRQ

19. 11. Out of all rectangles with a given perimeter, the _____ has the minimum area.

Mark only one oval.

- rhombus
- circle
- square
- parallelogram

20. 12. If the sum of n positive numbers is constant, then their product is maximum when the numbers are

Mark only one oval.

- positive
- negative
- equal
- None of these

21. 13. The particles in a molecular model follow

Mark only one oval.

- Discrete model
- Continuous model
- Linear model
- None of these

22. 14. The model in which every set of variable states is uniquely determined by parameters in the model and by sets of previous states of these variables is termed as

Mark only one oval.

- Deterministic model
- Probabilistic model
- Statistic model
- Stochastic model

23. 15. The model in which same set of parameter values and initial conditions will lead to an ensemble of different outputs, is

Mark only one oval.

- Deterministic model
- Probabilistic model
- Statistic model
- Stochastic model

24. 16. Which model follows the changes over time that results from the system activities?

Mark only one oval.

- Dynamic model
- Static model
- Analytical model
- Numerical model

25. 17. According to Newton's law of cooling "The change of temperature of a body is proportional to the difference between the temperature of a body and that of the surrounding medium". If T1℃ is the initial temperature of the body and T2℃ is the constant temperature of the medium, T℃ be the temperature of the body at any time t then find the expression for T℃ as a function of T1℃, T2℃ and time t.

Mark only one oval.

- T=T1+(T2)exp(-kt)
- T=T2+(T1-T2)exp(-kt)
- T2+(T1-T2)exp(kt)
- T=T2+(T1)exp(-kt)

26. 18.

A bottle of mineral water at a room temperature of 72°F is kept in a refrigerator where the temperature is 44°F.After half an hour water cooled to 61°F.What is the temperature of the body in another half an hour?(Take $log\ \frac{28}{17} = 0.498$, $e^{-0.99} = 0.37$)

Mark only one oval.

18°F

Option 1

9.4°F

Option 2

54.4°F

Option 3

36.4°F

Option 4

27. 19. How many milligrams of tritium will remain after 49.2 years if the starting amount is 32 mg? The half-life of tritium is 12.3 years.

Mark only one oval.

- 8 mg
- 2 mg
- 1 mg
- 4 mg

28. 20. What would be the remaining concentration of 300 g of radioactive substance after 18 hours if the half-life is 3 hours?

Mark only one oval.

- 9.37 g
- 2.34 g
- 3.34 g
- 4.68 g

29. 21. Two chemical substances combine in the ratio a:b to form a third substance Z. If z(t) is the amount of the third substance at time t and A & B are the initial amounts of two substances, then

Mark only one oval.

$\frac{dz}{dt} \propto \left(A - \frac{az}{a+b}\right)\left(B - \frac{bz}{a+b}\right)$

Option 1

$\frac{dz}{dt} \propto \left(A - \frac{az}{a+b}\right) \Big/ \left(B - \frac{bz}{a+b}\right)$

Option 2

$\frac{dz}{dt} \propto \left(B - \frac{bz}{a+b}\right) \Big/ \left(A - \frac{az}{a+b}\right)$

Option 3

None of these

Option 4

30. 22.

The velocity of a particle moving with simple harmonic motion is . . . . at the mean position.

Mark only one oval.

- zero
- minimum
- maximum
- none of these

31. 23.

Two balls of different masses (one lighter and one heavier) are thrown vertically upward with same initial speed. Which one will rise to a greater height?

Mark only one oval.

- the lighter one
- the heavier one
- both the balls
- none of these

32. 24.

The differential equation for the simple harmonic motion of a mass M attached to a spring with spring constant k is

Mark only one oval.

$y'(t)+\left(\frac{k}{M}\right)y(t)=0$

Option 1

$y''(t)+\left(\frac{k}{M}\right)y(t)=0$

Option 2

$y'(t)+kMy(t)=0$

Option 3

$y''(t)+kMy(t)=0$

Option 4

33. 25.

If $y_1(x)$ and $y_2(x)$ are linearly independent solutions to a second-order linear homogeneous differential equation (with continuous coefficient functions), then the general solution to this differential equation is

Mark only one oval.

Option 1: $y = c_1 y_1 + c_2 y_2$

Option 2: $y = c_1 y_1 + c_2 x y_2$

Option 3: $y = c_1 e^{y_1} + c_2 e^{y_2}$

Option 4: None of these

34. 26.

Consider a disease 'X'. People who are diagnosed in the earlier stage have high chance of recovery. But the intense infection of 'X' will lead to death. The recovered people also stand a chance to get infected again. What kind of model does this disease 'X' exhibit?

Mark only one oval.

- SIS
- SIR
- Both SIS & SIR
- None of these

35. 27. A stone is just released from the window of a train moving along a horizontal straight track. The stone will hit the ground following

Mark only one oval.

- Hyperbolic path
- Straight path
- Circular path
- Parabolic path

36. 28.

The equation $v\frac{dv}{dx} = \mu x$ represents

Mark only one oval.

- Simple harmonic motion
- Motion under gravity in a resisting medium
- Motion of a rocket
- None of these

37. 29. A body is thrown vertically upwards. If air resistance is to be taken into account, then the time during which the body rises is

Mark only one oval.

- Equal to the time of fall
- Less than the time of fall
- Greater than the time of fall
- Twice the time of fall

38. 30. Two stones of different masses are dropped simultaneously from the top of a building

Mark only one oval.

- Smaller stone hit the ground earlier
- Larger stone hit the ground earlier
- Both stones reach the ground simultaneously
- Which of the stones reach the ground earlier depends on the composition of the stone

39. 31.

The equation of the curve in which the tangent at a point is always perpendicular to the line joining the point to the origin is

Mark only one oval.

$(x-\alpha)^2+(y-\beta)^2=a^2$

Option 1

$x^2+y^2=a^2$

Option 2

$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$

Option 3

$\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$

Option 4

40. 32.

The differential equation for the family of curves $f(x,y,a)=0$ is in the form

Mark only one oval.

$\phi\left(x,y,\frac{dy}{dx},\frac{d^2y}{dx^2}\right)=0$

Option 1

$\phi\left(x,y,\frac{d^2y}{dx^2}\right)=0$

Option 2

$\phi\left(x,y,\frac{dy}{dx}\right)=0$

Option 3

None of these

Option 4

41. 33. Example predator-prey relationship?

Mark only one oval.

- A lion eating a zebra
- A zebra eating grass
- A human eating fruit
- None of these

42. 34.

In Domar Macro Model, if $S(t), I(t), Y(t)$ are the Savings, Investment and National Income respectively at time t then the assumption 'Investment is proportional to the rate of increase of national income' is represented by

Mark only one oval.

$S(t) = \alpha Y(t),\ \alpha > 0$

Option 1

$I(t) = \beta Y'(t),\ \beta > 0$

Option 2

$S(t) = I(t)$

Option 3

$I(t) = \beta Y(t),\ \beta > 0$

Option 4

43. 35.

A particle of mass m is projected from the origin in vacuum with velocity V inclined at an angle α to the horizontal. Suppose at time t, it is at position $x(t)$, $y(t)$ and ints horizontal and vertical velocity components are $u(t)$, $v(t)$ respectively, then the equation of motion are

Mark only one oval.

$m\frac{du}{dt}=mg,\ m\frac{dv}{dt}=-mg$

Option 1

$m\frac{du}{dt}=mg,\ m\frac{dv}{dt}=mg$

Option 2

$m\frac{du}{dt}=0,\ m\frac{dv}{dt}=-mg$

Option 3

$m\frac{du}{dt}=0,\ m\frac{dv}{dt}=mg$

Option 4

44. 36.

A particle of mass m is projected from the origin in vacuum with velocity V inclined at an angle α to the horizontal. Then the range of the particle is

Mark only one oval.

$\frac{V^2 \sin 2\alpha}{g}$

Option 1

$\frac{V \sin 2\alpha}{g}$

Option 2

$\frac{V^2 \cos 2\alpha}{g}$

Option 3

$\frac{V^2 \cos \alpha}{g}$

Option 4

45. 37. As per Kepler's laws of planetary motions, which of the following statements is correct?

Mark only one oval.

- ◯ Every planet describes an ellipse with the Sun at one focus.
- ◯ The radius vector from the Sun to a planet describes equal areas in equal intervals of time.
- ◯ The squares of periodic time of planets are proportional to the cubes of the semimajor axes of the orbits of the planet
- ◯ All of these

46. 38.

For hyperbolic orbit the values of energy E and eccentricity ϵ are _____

Mark only one oval.

$E=0$ and $\epsilon>1$

Option 1

$E>0$ and $\epsilon>1$

Option 2

$E>0$ and $\epsilon=1$

Option 3

$E>0$ and $\epsilon=0$

Option 4

47. 39.

For elliptical orbit the values of energy E and eccentricity ϵ are _____

Mark only one oval.

$E=0$ and $\epsilon>1$

Option 1

$E>0$ and $\epsilon>1$

Option 2

$E<0$ and $\epsilon<1$

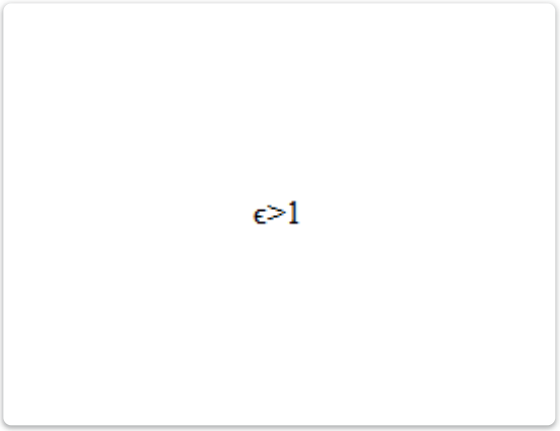
Option 3

$E>0$ and $\epsilon=0$

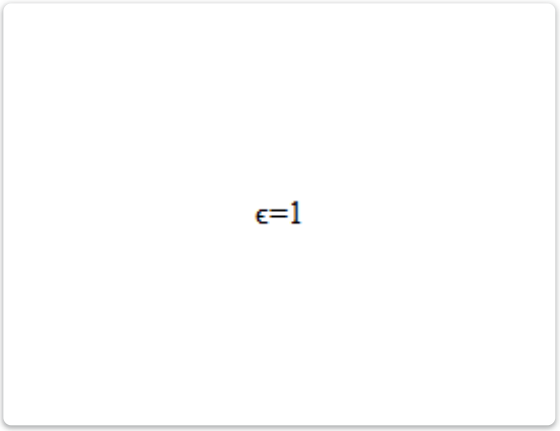
Option 4

48. 40. For circular orbit the value of eccentricity _____

Mark only one oval.



Option 1



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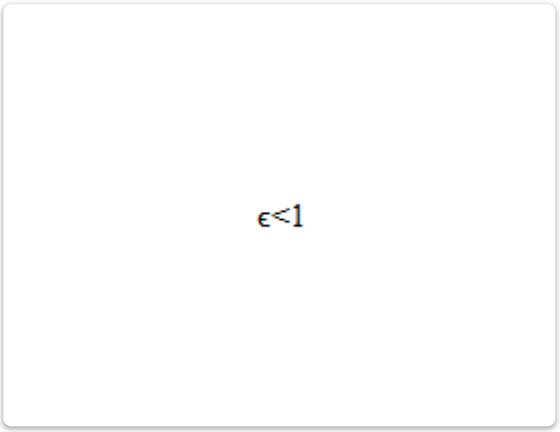

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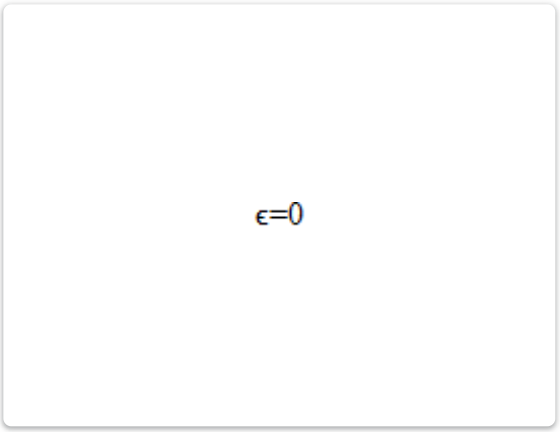

Option 4

49. 41. From Kepler's law of orbit, we can infer that the sun is located _____ of the planet's orbit.

Mark only one oval.

- at the centre
- at one of the foci
- at both foci
- anywhere along the semi-minor axis

50. 42.

The orthogonal trajectories of $\frac{x^2}{a^2+\lambda}+\frac{y^2}{b^2+\lambda}=1$ is

Mark only one oval.

$(xp+y)(x-py)=p(a^2-b^2)$

Option 1

$(xp-y)(x+py)=p(a^2-b^2)$

Option 2

$(xp+y)(x-py)=p(a^2+b^2)$

Option 3

$(xp-y)(x+py)=p(a^2+b^2)$

Option 4

51. 43.

The orthogonal trajectories of the family $r = 2a\cos\theta$ is

Mark only one oval.

$r = 2b\cos\theta$

Option 1

$r = 2b\sin\theta$

Option 2

$r = 2b\cot\theta$

Option 3

$r = 2b\tan\theta$

Option 4

52. 44. The range and maximum height of a projectile _____ by air resistance.

Mark only one oval.

- are increased
- are reduced
- remain unchanged
- None of these

53. 45. The mathematical model of the curves for which tangent makes constant angle with radius vector is represented by the differential equation

Mark only one oval.

$r\frac{dr}{d\theta}=\tan\alpha$

Option 1

$r\frac{d\theta}{dr}=\tan\alpha$

Option 2

$\frac{dr}{d\theta}=\tan\alpha$

Option 3

$\frac{d\theta}{dr}=\tan\alpha$

Option 4

54. 46. The velocity potential for irrotational flow satisfies

Mark only one oval.

- Wave equation
- Heat equation
- Laplace equation
- None of these

55. 47. For an incompressible fluid, the equation of continuity is

Mark only one oval.

$\frac{\partial \rho}{\partial t} + div\left(\rho \vec{V}\right) = 0$

Option 1

$\frac{\partial \rho}{\partial t} = div\left(\rho \vec{V}\right)$

Option 2

$div\left(\vec{V}\right) = 0$

Option 3

None of these

56. 48.

If $\rho = 0$, then the Poisson's equation, $\text{div}\left(\text{grad}\Phi\right) = -4\pi\rho$ becomes

Mark only one oval.

Wave equation

Heat equation

Laplace equation

None of these

57. 49.

The Euler-Lagrange equation of calculus of variations is in the form

Mark only one oval.

$\frac{\partial F}{\partial u}-\frac{\partial}{\partial x}\left(\frac{\partial F}{\partial u_x}\right)-\frac{\partial}{\partial y}\left(\frac{\partial F}{\partial u_y}\right)=0$

Option 1

$\frac{\partial F}{\partial u}+\frac{\partial}{\partial x}\left(\frac{\partial F}{\partial u_x}\right)+\frac{\partial}{\partial y}\left(\frac{\partial F}{\partial u_y}\right)=0$

Option 2

$\frac{\partial^2 F}{\partial u^2}-\frac{\partial}{\partial x}\left(\frac{\partial F}{\partial u_x}\right)-\frac{\partial}{\partial y}\left(\frac{\partial F}{\partial u_y}\right)=0$

Option 3

None of these

Option 4

58. 50. Which among these is used to specify a particular problem which we consider for solving in CFD?

Mark only one oval.

- Boundary conditions
- Governing equations
- Governing laws
- Solution method

59. 51.

The PDE $R(x,y)\frac{\partial^2 z}{\partial x^2}+S(x,y)\frac{\partial^2 z}{\partial x\partial y}+T(x,y)\frac{\partial^2 z}{\partial y^2}+f\left(x,y,z,\frac{\partial z}{\partial x},\frac{\partial z}{\partial y}\right)=0$ can be transformed to $\frac{\partial^2 \zeta}{\partial \xi^2}+\frac{\partial^2 \zeta}{\partial \eta^2}=\Phi\left(\xi,\eta,\zeta,\zeta_\xi,\zeta_\eta\right)$ if

Mark only one oval.

$S^2-4RT>0$

Option 1

$S^2-4RT=0$

Option 2

$S^2-4RT<0$

Option 3

None of these

Option 4

60. 52. The mathematical classification of inviscid flow equations are different from that of the viscous flow equations because of _____

Mark only one oval.

- absence of viscosity coefficients
- absence of higher order terms
- absence of convective terms
- absence of diffusive terms

61. 53. Which of these is not a type of flows based on their mathematical behaviour?

Mark only one oval.

- Circular
- Elliptic
- Parabolic
- Hyperbolic

62. 54. Which of these does not come under partial differential equations?

Mark only one oval.

- Laplace's equation
- Equations of motion
- 1-D wave equation
- Heat equation

63. 55. The diffusion equation is

Mark only one oval.

- elliptic
- parabolic
- hyperbolic
- None of these

64. 56. Where do we encounter partial differential equations in CFD?

Mark only one oval.

- Physical models
- Assumptions
- Governing equations
- Discretized equations

65. 57. Which of these models of fluid flow give complete partial differential equations directly?

Mark only one oval.

- Finite control volume moving along with the flow
- Finite control volume fixed in space
- Infinitesimally small fluid element fixed in space
- Infinitesimally small fluid moving along with the flow

66. 58. The governing equations of CFD are _____ partial differential equations.

Mark only one oval.

- Linear
- Quasi-linear
- Non-linear
- Non-homogeneous

67. 59. In a sensitivity analysis

Mark only one oval.

- We change parameter values to test their effect on the dynamics of the system
- We change the values of time and/or space
- We estimate the parameter values which better fit the experimental data
- We predict and analyze equilibrium states

68. 60. What is the maximum possible number of edges in a directed graph with no self loops having 8 vertices?

Mark only one oval.

- 28
- 64
- 256
- 56