This Question Booklet contains 12 printed pages

PGCH

Total Marks : 100
Time : 100 Minutes

Candidate's Seat No. :

Question Booklet Code : **A**

A
Seal Sticker

Candidate's Signature _____ **Block Supervisor's Signature** _____

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INSTRUCTIONS FOR CANDIDATE:

1. Check Number printed on your OMR SHEET and Question Paper with your SEAT No. before answering the questions. Consult block supervisors in case the above mentioned numbers do not match with your seat number.
2. There are total 100 questions. For answer of each question A, B, C, D, E options are given in OMR SHEET. In OMR SHEET, there is "E" option. "E" option is for "Not Attempted". If candidate do not wish to answer the question he/she should select "E" option (Not Attempted). All questions are compulsory.

   For Example:

   Which state of India has the longest sea shore ?

   A ◯ B ◯ C ● D ◯ E ◯

   (A) Maharashtra (B) Tamilnadu

   (C) Gujarat (D) Andhra Pradesh

   In this example, the right answer is (C). Therefore, the Circle of (C) has been darkened (encoded). Candidate should not give the answer "Gujarat" in writing.

   The options once darkened/answered by candidate cannot be changed.
3. Candidates are not permitted to leave examination hall during examination.
4. Candidates must strictly enter SEAT NO. in the designated space provided in OMR SHEET as well as Question Paper neatly as soon as they receive the OMR SHEET & Question Paper.
5. Candidates must not write name or put any identification sign/symbol on OMR SHEET. In such case strict disciplinary action will be taken against candidate & will be considered disqualified/ineligible. Only Seat No. must be entered at designated space provided in OMR SHEET.
6. Both, Candidate's & Supervisor's signature must be done on Certificate of OMR SHEET. Unsigned OMR SHEET would not be considered for evaluation.
7. Candidates are not permitted to use or carry with them any kind of literature, guide, hand written notes, or printed books, mobile phone, pagers, smart watches, camera or any electronic gadgets to examination hall.
8. Use of only Non-scientific / Non-programmable calculator shall allow during examination.
9. Candidates are not permitted to talk/discuss in the Examination Hall. Any candidate found violating supervisor's instructions will be disqualified.
10. Candidates must fully darken circle A, B, C, D and E accordingly with Blue / Black ball pen. If answers are marked with any other coloured ball pen, pencil, white ink (whitner), any corrections are done by candidate by means of blade or rubber or whitner will not be considered for evaluation.
11. Candidates may carry QP with them after Examination.
12. **For correct answer 1 (One) marks will be given.**

    If candidate gives more than one option as answer for one question in answer sheet (OMR SHEET), or gives wrong answer then the candidate will be allotted Zero (0) marks.

    If candidate does not want to answer a particular question and marks (E) or leave the option without encoding on OMR sheet, then no minus marks will be given.

Submit the OMR SHEET to the block supervisor after completion of examination without fail before leaving examination hall, failure to do so will result in disqualification of the candidature for the examination and disciplinary action will be taken against such candidate.

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1. A fluid is a substance that

(A) always expands until it fills any container

(B) is practically incompressible

(C) cannot be subjected to shear stress

(D) deforms continually in the presence of shear stress, regardless of the magnitude of the shear stress

2. Which law is not used to calculate the energy required for reduction in particle size of a solid?

(A) Rittinger's law (B) Bond's Law

(C) Kick's law (D) Fourier's law

3. Ammonium carbamate decomposition results in the synthesis of

(A) ammonium sulphate (B) DDT

(C) urea (D) diammonium phosphate

4. The available nitrogen in an urea sample is found to be 45% by mass. Determine the approximate actual urea content in the sample.

(A) 82% (B) 78%

(C) 96% (D) 54%

5. In liquids and gases, heat transmission is mainly caused by

(A) conduction (B) convection

(C) radiation (D) conduction and convection

6. Pore size is lowest in case of

(A) ultrafiltration membrane (B) microfiltration membrane

(C) reverse osmosis membrane (D) nanofiltration membrane

7. In Englis The Laplace transform of e^{-at} is

(A) 1 / (s - a) (B) 1 / (s + a)

(C) 1 / s (D) a / (s + a)

8. In autocatalytic reactions

(A) one of the product act as catalyst

(B) one of the reactant act as catalyst

(C) the initial rate of reaction is very high

(D) catalyst must be added externally

9. The new ISO standard for occupational health and safety (OH&S) is

(A) ISO 14001 (B) ISO 9000

(C) ISO 45001 (D) ISO 50001

10. Which of the following is not used as anti knocking agent in gasoline?

(A) methyl tertiary butyl ether (B) tetra ethyl lead

(C) ferrocene (D) polyalkyl naphthalene

11. Thermoplastics are formed by

(A) addition polymerization (B) copolymerization

(C) isomerism (D) condensation polymerization

12. Which of the following is not a positive displacement pump?

(A) centrifugal pump (B) piston pump

(C) diaphragm pump (D) plunger pump

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13. The fluid energy mill is a type of

(A) grinder (B) crusher

(C) ultra fine grinder (D) conveyor

14. Identify the correct Shift reaction for ammonia synthesis

(A) $CO + H_2O \rightarrow CO_2 + H_2$ (B) $CH_4 + H_2O \rightarrow CO + 3H_2$

(C) $N_2 + 3\ H_2 \rightarrow 2\ NH_3$ (D) $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

15. Calculate the amount of CO_2 produced in kg for complete combustion of 32 kg of Methane.

(A) 22 (B) 44

(C) 66 (D) 88

16. Negative sign in Fourier heat conduction equation indicates

(A) Heat always flow in the direction of positive temperature gradient

(B) Heat always flow in the direction of negative temperature gradient

(C) There is no heat flow

(D) Data is insufficient for any conclusion

17. Which of the following tray type is not used in distillation column?

(A) sieve tray (B) valve tray

(C) porous tray (D) bubble cap tray

18. Which kind of control system has offset as a characteristic?

(A) proportional (B) integral

(C) derivative (D) on-off

19. The catalyst in a first-order chemical reaction changes the

(A) activation energy (B) heat of reaction

(C) equilibrium constant (D) heat of formation of product

20. Fixed charges for a chemical plant does not include the

(A) interest on loan amount

(B) rent of land and building

(C) property tax, insurance and depriciation

(D) repair and maintenance expenses

21. What does zero discharge actually refer to in case of process plants?

(A) zero discharge of ions

(B) 100% efficient plant

(C) eliminate discharges, recycle and reuse all wastes, and minimize air emissions

(D) amount of influent equals the amount of effluent

22. Residue formed in the petroleum refining is

(A) wax (B) asphalt

(C) gas oil (D) ammonia

23. Which of the following polymerization is also known as pearl polymerization?

(A) suspension polymerization (B) bulk polymerization

(C) solution polymerization (D) emulsion polymerization

24. Which type of valve permit flow in one direction only?

(A) globe valve (B) butterfly valve

(C) check valve (D) gate valve

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25. Which parameter is determined indirectly without using any analytical equipment in proximate analysis of coal?

(A) Fixed carbon (B) Moisture

(C) Volatile organic content (D) Ash

26. What is flotation process in solid separation?

(A) Removal of fine particles by fine adsorbents

(B) Removal of fine particles by sedimentation

(C) Removal of fine particles by chelating agents

(D) Removal of fine particles by air bubbles

27. The compressibility factor (Z) of an ideal gas is always

(A) 0 (B) 1

(C) less than unity (D) greater than unity

28. Which is the correct Stefan-Boltzmann law of thermal radiation? σ = Stefan-Boltzmann constant

(A) $q = \sigma AT$ (B) $q = \sigma AT^2$

(C) $q = \sigma AT^3$ (D) $q = \sigma AT^4$

29. Which of the following separation process is categorized as rate governed separation process?

(A) separation by distillation (B) drying based separation

(C) membrane based separation (D) separation by adsorption

30. Which of the following temperature measuring devices is widely used to measure the temperature in furnaces?

(A) Resistance thermometer (B) Radiation pyrometer

(C) Iron-constantan thermocouple (D) Bimetallic thermometer

31. The half-life of a first order reaction is 30 min. Find the rate constant of the reaction in s^{-1}.

(A) 2.25×10^{-3} (B) 3.85×10^{-4}

(C) 2.77×10^{-4} (D) 5.55×10^{-3}

32. The Sum of the Years Digits (SYD) depreciation method determines depreciation at a rate

(A) faster than the straight-line method

(B) slower than the straight-line method

(C) more than the declining balance method

(D) equal to the declining balance method

33. The biochemical treatment of sewage effluents is essentially a process of

(A) alkalization (B) reduction

(C) oxidation (D) dehydration

34. Which of the following petroleum products has maximum flash point?

(A) gasoline (B) naphtha

(C) furnace oil (D) kerosene

35. Polymerization of phenol and formaldehyde result in the formation of

(A) Polyvinyl chloride (B) Bakelite

(C) Polyvinyl acetate (D) Teflon

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36. Sphericity for non-spherical particle, is defined as _____, Where, Vp = volume of particle, Dp = particle diameter, Sp = surface area of particle and Np = number of particle.

(A) 6Vp / DpNp (B) 6Vp / DpSp

(C) 6Sp / Np Vp (D) 6VpSp / Dp

37. Titanium dioxide is added in white paints to provide

(A) corrosion resistance (B) heat resistance

(C) whiteness and opacity (D) water resistance

38. A salt solution containing 6.5% salt by weight is mixed with pure water in a mixer to form a diluted salt solution. Sample from the dilute solution shows 0.5% salt by weight. What is ratio of flow in the two feed streams?

(A) 0.083 (B) 0.045

(C) 0.016 (D) 1.256

39. The critical thickness of insulation in case of cylindrical pipe is _____, where k is the thermal conductivity of pipe material and h is the film heat transfer coefficient.

(A) h / k (B) 2h / k

(C) k / 2h (D) k / h

40. A normal liquid solvent when reaches the supercritical stage should develop the following desirable properties for application in supercritical extraction process. Choose the wrong one.

(A) liquid like density (B) increase in surface tension

(C) gas like viscosity (D) diffusivity higher than liquid

41. Composition of alloys is commonly determined by

(A) thermal conductivity cell (B) polarimeter

(C) polarograph (D) thermocouple

42. The vessel dispersion number for PFR and CSTR respectively are

(A) unity and infinite (B) zero and unity

(C) infinite and zero (D) zero and infinite

43. The profitability index (PI) of a project is calculated by dividing the

(A) present value of future expected cash flows by the initial investment amount in the project

(B) present value of future expected cash flows by the total cash inflows

(C) present value of future expected cash flows by the present value of cash outflows

(D) future value of future expected cash flows by the initial investment amount in the project

44. The resistance offered by filter used in a fabric filter

(A) varies inversely with the particle size and directly with the dust concentration

(B) varies inversely with the dust concentration and directly with the particle size

(C) varies directly with the particle size as well with the dust concentration

(D) varies inversely with the particle size as well with the dust concentration

45. Octane number and cetane number is an important test for

(A) petrol and kerosene respectively (B) petrol and diesel respectively

(C) diesel and petrol respectively (D) petrol and LPG respectively

46. Butyl rubber which is a co-polymer of isoprene & isobutylene is commonly used for manufacturing

(A) flexible pipe (B) tubeless tyre

(C) gasket and seal (D) gumboot

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47. Losses of flow through valve and fittings is expressed in terms of

(A) roughness factor
(B) drag coefficient
(C) equivalent length of straight pipe
(D) NPSH

48. Which of the following size reduction equipment works on the principle of attrition and impact?

(A) jaw crusher
(B) gyratory crusher
(C) ball mill
(D) roller crusher

49. All of the following are cleaner production techniques except

(A) process modification
(B) on-site recycling
(C) material substitution
(D) waste water treatment

50. The Darcy friction factor for laminar flow through circular pipe is calculated as _____, where N_{Re} = Reynolds number

(A) $16 / N_{Re}$
(B) $24 / N_{Re}$
(C) $48 / N_{Re}$
(D) $64 / N_{Re}$

51. A solution of sodium chloride in water contains 20% NaCl (by mass). If the density of the solution is 1.127 kg/L, find the molarity of the solution.

(A) 3.85
(B) 4.25
(C) 2.55
(D) 5.65

52. Which of the following flow has the maximum heat transfer rate for a Double Pipe Heat Exchanger?

(A) counter flow
(B) parallel flow
(C) cross flow
(D) split flow

53. Which of the following unit operation is based on relative solubility of the different solvents?

(A) crystallization
(B) adsorption
(C) extraction
(D) distillation

54. Transfer lag is a characteristic of

(A) all higher order except first and second order systems
(B) all higher order except first order systems
(C) all higher order except second order systems
(D) first order systems only

55. A reaction is of zero order when the rate of reaction is

(A) directly proportional to the concentration of reactant
(B) inversely proportional to the concentration of reactant
(C) independent of the concentration of reactant
(D) independent of the temperature

56. Which of the following devices for particulate collection from a stream gas does not discharge the particulates collected as a dry solid?

(A) Cyclone separator
(B) Electrostatic precipitator
(C) Fabric filter
(D) Wet scrubber

57. Merox process is applied on refined petroleum products to

(A) remove mercaptans for reducing sulphur levels
(B) increase calorific value
(C) reduce viscosity and pour point
(D) reduce the odour of the fuel

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58. Polysulphone used as membrane material is a condensation product of

(A) bisphenol-A and dicholorodiphenyl sulphone

(B) bisphenol-A and vinyl sulphone

(C) bisphenol-A and carbonic acid

(D) bisphenol-A and diphenyl carbonate

59. 10 bar pressure is equivalent to

(A) 750 Torr

(B) 1000 Pa

(C) 145.038 lb/in^2

(D) 98.7 std. atm.

60. Which of the following is not suitable for prevention of swirling in an agitated cylindrical vessel?

(A) usage of inclined propeller

(B) multiple propeller on the same shaft

(C) installation of baffles in the vessel

(D) mounting off centre propeller

61. Which of the following statements are CORRECT?

P. For a rheopectic fluid, the apparent viscosity increases with time under a constant applied shear stress

Q. For a pseudoplastic fluid, the apparent viscosity decreases with time under a constant applied shear stress

R. For a Bingham plastic, the apparent viscosity increases exponentially with the deformation rate

S. For a dilatant fluid, the apparent viscosity increases with increasing deformation rate

(A) P and Q only

(B) R and S only

(C) Q and R only

(D) P and S only

62. Oleum, or fuming sulfuric acid is

(A) sulphuric acid which gives fumes of sulphur dioxide

(B) sulphuric acid saturated with sulphur trioxide

(C) a mixture of concentrated sulphuric acid and sulphur

(D) a mixture of sulphuric and nitric acid

63. The Vanderwaals equation of state is used for

(A) ideal liquid

(B) ideal gas

(C) real gas

(D) both ideal and real gas

64. In a pool boiling experiment, the following phenomena were observed.

P. Natural convection

Q. Film boiling

R. Transition boiling

S. Nucleate boiling

What was the CORRECT sequence of their occurrence?

(A) P, Q, S, R

(B) P, R, S, Q

(C) P, Q, R, S

(D) P, S, R, Q

65. The Knudsen diffusivity is proportional to _____, where T = absolute temperature

(A) T

(B) T^2

(C) $T^{1/2}$

(D) $T^{2/3}$

66. Which of the following is considered the strongest tool for determining the stability and transient response?

(A) Bode plot

(B) Nyquist plot

(C) Root locus method

(D) Time domain analysis

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67. For the same residence time, which type of reactor arrangement will give the maximum conversion?

(A) Single stirred tank (volume = 5 litres)

(B) Two stirred tank (each of volume = 2.5 litres) in series

(C) Stirred tank followed by tubular flow reactor (each of volume = 2.5 litres)

(D) Single tubular flow reactor (volume = 5 litres)

68. The temperature at which an amorphous polymer changes from a hard / glassy state to a soft / leathery state is known as

(A) glass transition temperature (B) polymer transformation temperature

(C) softening point temperature (D) phase transition temperature

69. Which method is not applied for producing caustic soda through the electrolysis of brine?

(A) mercury cell process (B) membrane cell process

(C) diaphragm cell process (D) zeolite cell process

70. The temperature and pressure condition at which solid, liquid and gas phase of a substance coexist in thermodynamic equilibrium is known as

(A) triple point (B) supercritical point

(C) eutectic point (D) ionic point

71. Which stream is used to remove accumulation of inert or unwanted material that might otherwise build up in the process streams?

(A) bypass stream (B) purge stream

(C) recycle stream (D) waste stream

72. The cooling effect in a cooling tower can be increased by

(A) lowering the barometric pressure

(B) reducing the humidity of entering air

(C) increasing the air velocity over the wet surfaces

(D) all the above methods can be applied

73. The overall rate of a multi-step reaction is determined by

(A) the rate of fastest intermediate step

(B) the sum total of the rates of all intermediate steps

(C) the rate of slowest intermediate step

(D) the average of the rates of all the intermediate steps

74. Which one of the following systems does not form azeotrope at atmospheric condition?

(A) ethanol-water (B) benzene-toluene

(C) acetone-chloroform (D) hydrogen chloride-water

75. Extensive properties of a thermodynamic system depend upon the _____ of the system.

(A) mass (B) temperature

(C) specific volume (D) pressure

76. In a distillation column operation total reflux requires

(A) minimum reboiler load (B) minimum condenser load

(C) minimum number of plates (D) infinite number of plates

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77. For a counter-flow shell-and-tube heat exchanger, cold fluid enters at 30°C and leaves at 50°C, whereas the hot fluid enters at 140°C and leaves at 120°C. What is the mean temperature difference?

(A) 70°C (B) 90°C

(C) 100°C (D) cannot be determined

78. Which one of the following is NOT CORRECT

(A) NYLON-6,6 is produced by condensation polymerization

(B) Phenol-formaldehyde resin is a thermosetting polymer

(C) High density polyethylene (HDPE) is produced by condensation polymerization

(D) Poly (ethylene terephthalate) (PET) is a polyester

79. In petroleum refining operation, the process used for converting paraffins and naphthenes to aromatics is

(A) alkylation (B) hydrocracking

(C) isomerization (D) catalytic reforming

80. What is the order of preference of the various elements in integrated waste management hierarchy (highest performance to lowest performance)?

(A) Reduce > Reuse & recycle > Energy recovery > Landfilling

(B) Reuse & recycle > Reduce > Energy recovery > Landfilling

(C) Reduce > Energy recovery > Reuse & recycle > Landfilling

(D) Reuse & recycle > Energy recovery > Reduce > Landfilling

81. Eigen values of the matrix "A" are _____, where $A=\begin{bmatrix}5 & 4\\ 1 & 2\end{bmatrix}$

(A) 1, 6 (B) 5, 2

(C) –1, 6 (D) 5, –2

82. Which of the following Statements are true in general?

Statement 1 : Singular matrix is always a square matrix.

Statement 2 : Every square matrix has determinant.

Statement 3 : Every square matrix satifies its own characteristics equation.

(A) Only Statement 1 (B) Statement 1 and 2

(C) Statement 1 and 3 (D) Statement 2 and 3

83. Which of the following is correct pair of Cauchy - Riemann Equations ?

Here $f(z) = u(x,y) + i\, v(x,y)$ is given.

(A) $\frac{\partial u}{\partial y}=\frac{\partial v}{\partial x}$ and $\frac{\partial u}{\partial x}=\frac{\partial v}{\partial y}$ (B) $\frac{\partial u}{\partial y}=\frac{-\partial v}{\partial x}$ and $\frac{\partial u}{\partial x}=\frac{-\partial v}{\partial y}$

(C) $\frac{\partial u}{\partial x}=\frac{\partial v}{\partial x}$ and $\frac{\partial u}{\partial y}=\frac{-\partial v}{\partial y}$ (D) $\frac{\partial u}{\partial x}=\frac{\partial v}{\partial y}$ and $\frac{\partial u}{\partial y}=\frac{-\partial v}{\partial x}$

84. Evaluate $\lim_{x \to a} \frac{\log(x-a)}{\log(e^x - e^a)}$

(A) 0 (B) 1

(C) -1 (D) None of the above

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85. Find $\frac{dy}{dx}$ if $x^3 + y^3 = 7xy$.

(A) $(7y - 3x^2) / (3y^2 - 7x)$ (B) $(3x^2 - 7y) / (3y^2 - 7x)$

(C) $(3y^2 - 7x) / (7y - 3x^2)$ (D) None of the above

86. Find the directional derivative of $x^2 y^2 z^2$ at the Point (1, 1, –1) in the direction of the tangent to the curve $x = e^t$, $y = \sin 2t + 1$ and $z = 1 - \cos t$ at $t = 0$.

(A) 0 (B) 1

(C) $\frac{6}{\sqrt{5}}$ (D) $\frac{5}{\sqrt{6}}$

87. Laplace Transform of $t^3 . e^{-2t}$ is _____

(A) $3! / (S - 2)^4$ (B) $3! / (S + 2)^4$

(C) $4! / (S - 2)^4$ (D) $4! / (S + 2)^4$

88. If $x = r\cos\theta$, $y = r\sin\theta$ then find out Jacobian $\frac{\partial(x, y)}{\partial(r, \theta)}$

(A) r (B) 1/r

(C) 0 (D) 1

89. Which of the following is an iterative method to solve ordinary differential equations?

(A) False Position Method (B) LU Decomposition method

(C) Newton-Raphson Method (D) Picard's method

90. Find the inverse Laplace Transform of the function $\frac{5}{(S-2)(S+3)}$

(A) $e^{-2t} + e^{-3t}$ (B) $e^{-2t} + e^{3t}$

(C) $e^{-2t} - e^{3t}$ (D) $e^{2t} - e^{-3t}$

91. The solution of differential equation $\frac{dy}{dx} = e^{x+y}$ is _____.

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

(C) $e^x - e^y = c$ (D) $e^x - e^{-y} = c$

92. Solve the differential equation, $\frac{d^2y}{dx^2} - 5\frac{dy}{dx} + 6y = e^{4x}$

(A) $y = \frac{1}{2}e^{4x} + c_1 + c_2 x$ (B) $y = c_1 e^{2x} + c_2 e^{-3x} + x$

(C) $y = c_1 e^{2x} + c_2 e^{3x} + \frac{1}{2}e^{4x}$ (D) None of above

93. The probability of an Impossible event is _____

(A) 0 (B) 1

(C) Between 0 and 1 (D) None of the above

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94. Evaluate $\int_0^1 \frac{1}{1+x}dx$ taking h = 1 using Simpson's $\frac{1}{3}$ rule. (correct up to 3 decimal places)

(A) 1.0092 (B) 1.1959

(C) 1.1991 (D) 1.2172

95. Evaluate $\oint \frac{e^z}{z^2+1}dz$ over the circle $|z| = 2$

(A) $2\pi i$ (B) Sin(1)

(C) $2\pi i.\sin(1)$ (D) $2\pi i / \sin(1)$

96. Find the residue of $\frac{1}{(z+1)^4}$ at its pole.

(A) 0 (B) 1

(C) –1 (D) 5/9

97. For a Binomial Distribution with n = 20, p = 0.35 (probability of success) then find Variance

(A) 2.45 (B) 4.55

(C) 8.45 (D) 4.3225

98. Two unbaised dice are tossed simutaneously. Find the probability that the sum of numbers on the upper face of dice is 9 or 12.

(A) 4/36 (B) 1/36

(C) 5/36 (D) None of the above

99. Find the median of 10, 23, 18, 38, 65, 92, 40, 58

(A) 38 (B) 65

(C) 40 (D) 39

100. For $F(x,y)$ we define,

$$r=\frac{\partial^2 F}{\partial x^2}, S=\frac{\partial^2 F}{\partial x \partial y}, t=\frac{\partial^2 F}{\partial y^2}$$

Which of the following condition is true for $F(x,y)$ to have maxima?

(A) $rt - S^2 < 0, r > 0$ (B) $rt - S^2 < 0, r < 0$

(C) $rt - S^2 > 0, r > 0$ (D) $rt - S^2 > 0, r < 0$

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