004/2026

Question Booklet Alpha Code **A**

Question Booklet Serial Number

Total No. of questions : 100 Time : 1 Hour 30 Minutes

Maximum : 100 Marks

INSTRUCTIONS TO CANDIDATES

1. The question paper will be given in the form of a Question Booklet. There will be four versions of question booklets with question booklet alpha code viz. A, B, C & D.
2. The Question Booklet Alpha Code will be printed on the top left margin of the facing sheet of the question booklet.
3. The Question Booklet Alpha Code allotted to you will be noted in your seating position in the Examination Hall.
4. If you get a question booklet where the alpha code does not match to the allotted alpha code in the seating position, please draw the attention of the Invigilator IMMEDIATELY.
5. The Question Booklet Serial Number is printed on the top right margin of the facing sheet. If your question booklet is un-numbered, please get it replaced by new question booklet with same alpha code.
6. The question booklet will be sealed at the middle of the right margin. Candidate should not open the question booklet, until the indication is given to start answering.
7. Immediately after the commencement of the examination, the candidate should check that the question booklet supplied to him contains all the 100 questions in serial order. The question booklet does not have unprinted or torn or missing pages and if so he/she should bring it to the notice of the Invigilator and get it replaced by a complete booklet with same alpha code. This is most important.
8. A blank sheet of paper is attached to the question booklet. This may be used for rough work.
9. **Please read carefully all the instructions on the reverse of the Answer Sheet before marking your answers.**
10. Each question is provided with four choices (A), (B), (C) and (D) having one correct answer. Choose the correct answer and darken the bubble corresponding to the question number using Blue or Black Ball-Point Pen in the OMR Answer Sheet.
11. **Each correct answer carries 1 mark and for each wrong answer 1/3 mark will be deducted. No negative mark for unattended questions.**
12. No candidate will be allowed to leave the examination hall till the end of the session and without handing over his/her Answer Sheet to the Invigilator. Candidates should ensure that the Invigilator has verified all the entries in the Register Number Coding Sheet and that the Invigilator has affixed his/her signature in the space provided.
13. Strict compliance of instructions is essential. Any malpractice or attempt to commit any kind of malpractice in the Examination will result in the disqualification of the candidate.

004/2026

Maximum : 100 marks

Time : 1 hour and 30 minutes

1. Which of the following statements are true about any $n \times n$ matrices A and B ?

(i) $Rank(A) = Rank(A^T)$, where A^T is the transpose of A

(ii) $Rank(A) = Rank(A^{-1})$, if A is invertible

(iii) $Rank(A+B) = Rank(A) + Rank(B)$

(iv) $Rank(AB) = Rank(A) \times Rank(B)$, the usual product

(A) (i) and (iii)
(B) (i) and (ii)
(C) (ii) and (iv)
(D) (ii) and (iii)

2. Suppose that a singular 3×3 matrix A has its trace (sum of diagonal entries) $\frac{3}{2}$. If it is also given that $Av = \begin{bmatrix} 1 \\ 1 \\ 2 \end{bmatrix}$ for $v = \begin{bmatrix} 2 \\ 2 \\ 4 \end{bmatrix}$, which are the possible eigenvalues of A?

(A) $1, 0, \frac{1}{2}$
(B) $0, 2, -\frac{1}{2}$
(C) $\frac{1}{2}, 0, -1$
(D) $\frac{1}{2}, -\frac{3}{2}, 1$

3. What is the coefficient of x^5 in the Taylor series expansion of $\frac{3x}{4-x^2}$ at 0?

(A) $\frac{3}{16}$
(B) 0
(C) $\frac{3}{64}$
(D) None of the above

4. Find the Laplace transform of $\cos^2 2t$:

(A) $\frac{18}{s^3+36s}$
(B) $\frac{s^2+8}{s^3+16s}$
(C) $\frac{s}{s^3+16s}$
(D) None of the above

5. If the Laplace transforms of the solutions of a second order homogenous linear differential equation with constant coefficients are given by $\frac{1}{s-3}$ and $\frac{2}{s+5}$, find out the differential equation :

(A) $y'' - 8y' + 15y = 0$ (B) $y'' + 2y' - 15y = 0$

(C) $y'' + 8y' - 15y = 0$ (D) $y'' - 2y' + 15y = 0$

6. Solution of the differential equation $y' + 5x^4 y = 2xe^{-x^5}$ is :

(A) $(C + x^2)e^{x^5}$ (B) $(C + x)e^{-x^5}$

(C) $(C + x)e^{x^5}$ (D) $(C + x^2)e^{-x^5}$

7. Evaluate the complex integral $\oint_C \frac{2z^2 - 3}{(z - \sqrt{2})(\sqrt{2}\, z - 1)} dz$, where C is the unit circle $|z| = 1$ taken in the counter clockwise sense :

(A) $2\pi i$ (B) $8\pi i$

(C) $4\pi i$ (D) None of these

8. The complex function $f(z) = z^2 + |z|^2$ is :

(A) analytic at origin

(B) not analytic at origin and both its real and imaginary parts are not harmonic functions

(C) not analytic at origin but real part is harmonic

(D) not analytic at origin but imaginary part is harmonic

9. The constant term in the Fourier cosine series expansion of $f(x) = \sin^2 x$ in the interval $[0, x]$ is :

(A) $\frac{1}{2}$

(B) $\frac{1}{4}$

(C) 0

(D) $f(x)$ is not expandable as cosine series

10. Which of the following is the scalar potential of the vector valued function $\vec{f}\ (x, y) = (x^2 - 4xy)\ \boldsymbol{i} + 2x^2\ \boldsymbol{j}$?

(A) $\frac{x^3}{3} + 2x^2 y + C$ (B) $\frac{x^3}{3} + 2x^2 y + 2x^2 + C$

(C) $\frac{x^3}{3} - 2x^2 y + C$ (D) Scalar potential does not exist

11. Gypsum is added to cement to prevent :

(A) Hydration
(B) Hardening
(C) Flash Setting
(D) Delayed Setting

12. According to IS 10262-2019, High strength concrete is the concrete that has characteristic compressive strength of :

(A) 60 N/mm^2 and above
(B) 65 N/mm^2 and above
(C) 70 N/mm^2 and above
(D) 75 N/mm^2 and above

13. Retrofitting methods used in damaged RC structures after an earthquake is :

(A) Jacketing
(B) Shotcreting
(C) External Prestressing
(D) All the above

14. A bar of diameter 30 mm is subjected to a tensile load such that the measured extension on a gauge length of 200 mm is 0.09 mm and the change in diameter is 0.0045 mm. Poisson's ratio of the material will be :

(A) 1/40
(B) 1/30
(C) 1/4
(D) 1/3

15. A cantilever beam of span 4 m, width 0.3 m and 0.4 m depth is subjected to a concentrated load of 12 kN at the free end. Neglecting self-weight, the maximum bending stress at a fixed end will be :

(A) 4.8 N/mm^2
(B) 5.0 N/mm^2
(C) 6.0 N/mm^2
(D) 6.5 N/mm^2

16. A simply supported beam (A) of span 5 m and breadth 230 mm and depth 400 mm is subjected to a concentrated load of 10 kN on the midspan. Another identical beam (B) carries UDL 2 kN/m over the entire span. The ratio of the maximum deflections of beam A and B will be

(A) 8/5
(B) 5/3
(C) 3/5
(D) 3/8

17. When the workability of concrete is very high, the preferred test for measurement of workability is :

(A) Slump test
(B) Compacting factor test
(C) Flow test
(D) Vee Bee Consistometer test

18. In RC design, for reinforcements bars in compression the value of bond stress for bars in tension may be increased by :

(A) 60% (B) 30%

(C) 25% (D) 10%

19. As per IS 800-2007, the design strength of tension member corresponding to gross section yielding is given by :

(A) $f_y A_g / \gamma_{m0}$ (B) $\gamma_{m0} f_y A_g$

(C) $\gamma_{m1} f_y A_g$ (D) $f_y A_g / \gamma_{m1}$

20. The class 10 bricks, when tested after immersion in cold water for 24 hours, water absorption shall not be more than _____ percent by weight.

(A) 12.5% (B) 15%

(C) 20% (D) 22%

21. In steel beams, lateral tensional buckling occurs when :

(A) Beams have laterally unsupported tension flange

(B) Beams have laterally unsupported compression flange

(C) Beams have laterally supported compression and tension flange

(D) None of these

22. In a built-up compression member with double laced system, the lacing bars must be designed to resist :

(A) 25% of the axial force in the main member

(B) 5% of the total compressive force in the member

(C) 2.5% of the total axial force in the main member

(D) 50% of the axial force in the main member

23. A residential building has a plinth area of 200 m^2. The plinth area rate is Rs.2500/m^2. The annual rent expected is Rs. 50,000. If the rate of interest is 5% per annum, the capitalized value of the property is approximately Rs. :

(A) 5,00,000 (B) 8,00,000

(C) 10,00,000 (D) 20,00,000

24. For an activity in a PERT network with optimistic time 4 days, most likely time 6 days and pessimistic time 10 days, the expected duration of the activity is :

(A) 4.0 days (B) 6.33 days

(C) 6.0 days (D) 10.0 days

25. A T-section is formed by a flange 100 mm × 10 mm placed on a web 10 mm × 100 mm. The distance of centre of gravity from base of the web (in mm) is :

(A) 27.5 (B) 32.5

(C) 55 (D) 77.5

26. A sight length of 1000 m is taken in differential levelling. Calculate the combined correction for curvature and refraction :

(A) – 0.056 m (B) – 0.067 m

(C) – 0.078 m (D) – 0.089 m

27. The number of satellites required for 3-D positioning in GPS :

(A) 2 (B) 3

(C) 4 (D) 5

28. A small orifice is discharging under a constant head. If the head is quadrupled, the theoretical discharge will :

(A) Double (B) Quadruple

(C) 8 times (D) Half

29. The specific speed of a turbine increases with :

(A) Decreasing discharge (B) Decreasing speed

(C) Increasing power (D) Decreasing head

30. The area under a unit hydrograph represents :

(A) Peak discharge (B) Total rainfall

(C) Unit runoff (D) Lag time

31. Specific yield of an unconfined aquifer is always :

(A) Equal to porosity (B) Less than porosity

(C) Greater than porosity (D) Independent of porosity

32. The void ratio of a soil sample is 0.8 and the specific gravity of solids is 2.7. What is the porosity of the soil?

(A) 0.32 (B) 0.44

(C) 0.55 (D) 0.67

33. The time for a clay layer to achieve 90% consolidation is 20 years. The time required to achieve 90% consolidation in the clay layer of half thickness is :

(A) 20 years (B) 5 years

(C) 10 years (D) 7.5 years

34. The most reliable field test for determining bearing capacity of soil for shallow foundations is :

(A) Standard Penetration Test (B) Plate Load Test

(C) Cone Penetration Test (D) Vane Shear test

35. Vibro-compaction is most effective for :

(A) Clayey (B) Peaty

(C) Clean saturated sands (D) Expansive

36. The headlight sight distance is mainly used for the design of :

(A) Horizontal curves (B) Summit curves

(C) Valley curves (D) Transition curves

37. If traffic density is 30 veh/km and space mean speed is 60 km/h, then the flow in vehicles per hour is :

(A) 1000 (B) 1200

(C) 1500 (D) 1800

38. A train at 90 km/h requires equilibrium cant of 100 mm and an actual cant of 75 mm. Then the cant deficiency is :

(A) 10 (B) 15

(C) 20 (D) 25

39. The best shape of a tunnel (sewer) for carrying sewage is :

(A) Circular (B) Rectangular

(C) Egg-shaped (D) Horseshoe

40. Airport site is at MSL with level ground. The basic runway length is 2000 m. The airport reference temperature is 45°C, and the standard atmospheric temperature at MSL is 15°C. What is the actual runway length?

(A) 2200 (B) 2400

(C) 2600 (D) 2800

41. Initial dissolved oxygen and the 5^{th} day dissolved oxygen of a wastewater sample is 8 mg/L and 5 mg/L respectively (5 ml of the wastewater sample was taken in the BOD bottle). Calculate the 5^{th} day BOD:

(A) 120 mg/L (B) 150 mg/L

(C) 180 mg/L (D) 210 mg/L

42. The ratio of friction factor and coefficient of friction used in the general equation for determining head loss in a pipe is :

(A) 0.25 (B) 0.50

(C) 2.0 (D) 4.0

43. The permissible limit of total hardness (as $CaCO_3$ in mg/L) in drinking water as per IS 10500:2012 is :

(A) 200 (B) 250

(C) 400 (D) 600

44. The maximum velocity in a circular sewer is obtained :

(A) The sewer is running full

(B) The depth of flow is 0.81 times full depth

(C) The depth of flow is 0.95 times full depth

(D) None of these

45. The value of Biochemical Oxygen Demand (BOD) for safe drinking water is :

(A) Nil (B) 5

(C) 10 (D) 15

46. The effluent coming from a septic tank are discharged into :

(A) Open drain (B) Oxidation pond

(C) Sewer (D) Soak pit

47. The process of removal of oil and grease from wastewater is known as :

(A) Screening (B) Sedimentation

(C) Skimming (D) Filtration

48. The value pH = 3 when compared to pH = 5 will be more acidic by :

(A) 2 times (B) 20 times

(C) 100 times (D) 200 times

49. The coagulant used in water treatment process when the pH of the water sample is in the range 4 to 7 is :

(A) Chlorinated Copperas (B) Copperas

(C) Lime (D) Alum

50. A 12.5 mL of treated wastewater requires 187.5 mL of odour-free distilled water to reduce the odour to a level that is just perceptible. What is the Threshold Odour Number (TON) for the wastewater sample :

(A) 15 (B) 16

(C) 17 (D) 18

51. The work done by the pump to lift $0.1 m^3/s$ of water to a height of 10 m is (Neglect frictional loss and other losses and assume the value of unit weight of water as $10 kN/m^3$) :

(A) 0.1 kW (B) 1 kW

(C) 10 kW (D) 100 kW

52. What is the theoretical oxygen demand of 300 mg/L glucose solution?

(A) 300 mg/L (B) 320 mg/L

(C) 340 mg/L (D) 360 mg/L

53. According to the National Ambient Air Quality Standards (NAAQS) in India for industrial areas, which of the following correctly matches a pollutant with its prescribed 24-hour average concentration limit?

(A) Nitrogen dioxide (NO_2) – 120 $\mu g/m^3$

(B) Respirable Suspended Particulate Matter (RSPM/PM_{10}) – 80 $\mu g/m^3$

(C) Sulphur Dioxide (SO_2) – 120 $\mu g/m^3$

(D) Ammonia (NH_3) – 400 $\mu g/m^3$

54. The greenhouse effect primarily refers to :

(A) The trapping of ultraviolet radiation by the ozone layer

(B) The natural process where certain gases in the atmosphere trap heat radiated from the Earth's surface

(C) The warming caused directly by solar radiation hitting the Earth

(D) The depletion of the stratospheric ozone shield

55. The dispersion pattern (plume behaviour) of pollutants emitted from a stack is determined by the prevailing atmospheric stability. Match the plume type listed in Column I with its correct atmospheric condition and characteristic as described in Column II.

Column I (Plume Type)		Column II (Atmospheric Condition and Characteristic)	
I.	Lofting Plume	1.	Occurs under extreme inversion; plume spreads only horizontally with minimal vertical mixing
II.	Fanning Plume	2.	Results from a surface inversion with super-adiabatic conditions above the stack; excellent dispersion with no ground contact
III.	Fumigating Plume	3.	Caused by an inversion layer *above* the stack and unstable conditions *below*; pollutants are forced downward to the ground
IV.	Trapping Plume	4.	Occurs when inversion layers exist both above and below the stack, confining the plume vertically between them
V.	Looping Plume	5.	Associated with super-adiabatic (highly unstable) conditions; exhibits a wavy, undulating pattern with potential for high ground-level concentrations

Choose the correct matching sequence from the options below :

(A) I-2, II-1, III-3, IV-4, V-5

(B) I-5, II-3, III-1, IV-4, V-2

(C) I-3, II-1, III-5, IV-2, V-4

(D) I-1, II-2, III-4, IV-5, V-3

56. A new cement plant is being designed to meet stringent particulate emission standards. The primary dust source is the rotary kiln exhaust, which contains a high concentration of fine particles (predominantly in the 1–10 μm range) at a temperature of 120°C. The plant requires a final control device with a collection efficiency greater than 99% and minimal secondary waste generation.

Based on typical engineering criteria-collection efficiency, applicable particle size range, and operational constraints-which of the following air pollution control devices would be the **LEAST suitable** choice for this application?

(A) Bag filter
(B) Electrostatic precipitator
(C) Cyclone Separator
(D) Venturi Scrubber

57. What is the approximate per capita generation rate of municipal solid waste in India?

(A) 2.8 kg/day
(B) 0.9 kg/day
(C) 0.5 kg/day
(D) 0.1 kg/day

58. What does the C/N ratio refer to in the context of composting, and what is its optimal range?

(A) Carbon/Nitrogen ratio; 30:1
(B) Calcium/Nitrogen ratio; 20:1
(C) Compost/Nutrient ratio; 50:1
(D) Chemical/Neutral ratio; 7:1

59. What is the main objective of "source reduction" in solid waste management?

(A) To reduce the volume of waste after it is generated
(B) To minimize the amount of waste generated at the origin
(C) To recycle all waste materials
(D) To safely dispose of hazardous waste

60. What is the role of the "State Advisory Body" constituted under the Solid Waste Management rules, 2016?

(A) Monitor compliance of local bodies
(B) Advise State Government on policy and implementation
(C) Issue authorization for waste processing plants
(D) Impose penalties

61. As per the safety guide (2021) of Atomic Energy Regulatory Board, 'Long-lived Waste' refers to radioactive waste that contains significant levels of radionuclides with half-life :

(A) Greater than 20 years
(B) Greater than 30 years
(C) Greater than 40 years
(D) Greater than 50 years

62. Resin identification Code '5' corresponds to which plastic resin type?

(A) Polystyrene
(B) Polypropylene
(C) Low Density Polyethylene
(D) Poly Vinyl Chloride

63. Which of the following statements is true for the ambient air quality standards in respect of noise as per the Noise Pollution Rules 2000?

(A) Day time refers to 8.00 am to 8.00 pm
(B) Night time refers to 9.00 pm to 6.00 am
(C) The limit for noise in silence zone for day time is 50 dB(A) Leq
(D) The limit for noise in silence zone for night time is 50 dB(A) Leq

64. Identify the cause for bleaching of corals :

(A) Increase in ocean salinity
(B) Increase in ocean pH
(C) Expulsion of zooxanthellae
(D) All the above

65. Which of the following Shared Socioeconomic Pathways (SSPs) of the Assessment Report 6 of IPCC represents the scenario: "Middle of the Road (Medium challenges to mitigation and adaptation)"?

(A) SSP1
(B) SSP2
(C) SSP3
(D) SSP4

66. Which of the following statements is/are true?

(A) Kigali Amendment aimed at phasing down chlorofluorocarbons
(B) Montreal Protocol aimed to phase out substances that deplete the ozone layer, such as hydrofluorocarbons
(C) Both (A) and (B)
(D) None of the above

67. Which of the following is/are true with respect to the second commitment period of the Kyoto protocol?

(A) Parties committed to reduce GHG emissions by at least 18% below 1990 levels
(B) Parties committed to reduce GHG emissions by at least 5% below 1990 levels
(C) Parties committed to reduce GHG emissions by atleast 5% below the first commitment period
(D) Both (A) and (C)

68. In COP26, the participants joining the Global Methane Pledge agreed to take voluntary actions to contribute to a collective effort to reduce global methane emissions :

(A) Atleast 25 percent from 2020 levels by 2030

(B) Atleast 25 percent from 2020 levels by 2050

(C) Atleast 30 percent from 2020 levels by 2030

(D) Atleast 30 percent from 2020 levels by 2050

69. The broad technical correspondences of which all standards are identified in the Annex B of ISO 14001:2004 (E) ?

(A) ISO 14001:2004 and ISO 9000:2000

(B) ISO 14001:2004 and ISO 9001:2000

(C) ISO 14001:2004 and ISO 9000:2004

(D) ISO 14001:2004 and ISO 9001:2004

70. _____ in relation to any factory or premises, means the person who has control over the affairs of the factory or the premises and includes, in relation to any substance, the person in possession of the substance as per the Air (Prevention and Control of Pollution) Act, 1987.

(A) Owner

(B) Producer

(C) Occupier

(D) Investor

71. If the IGBC rating for a green home (multi-dwelling residential unit) is 68, identify its certification and recognition :

(A) Silver certified, National excellence

(B) Certified, National excellence

(C) Gold certified, Outstanding performance

(D) Silver certified, Outstanding performance

72. Heat transfer fluids in solar energy systems in cold climate should possess which of the following properties :

(A) Low freezing point and low viscosity

(B) Low freezing point and high viscosity

(C) High freezing point and low viscosity

(D) High freezing point and high viscosity

73. An Emission Reduction Unit (ERU) is a trading unit under the Kyoto Protocol emissions trading scheme is generated by which of the following Kyoto mechanism/mechanisms?

(A) Joint implementation

(B) International Emissions Trading

(C) Clean Development Mechanism

(D) Both (A) and (C)

74. Which of the following is a Negative Emission Technology?

(A) Bioenergy with Carbon Capture and Storage (BECCS)

(B) Direct Air Carbon Capture and Storage (DACCS)

(C) Both (A) and (B)

(D) None of the above

75. The ratio of pollutant concentration in the plant parts to that in the media is known as :

(A) Translocation Factor

(B) Accumulation Factor

(C) Bioconcentration Factor

(D) Phytoremediation Factor

76. Choose the correct statements from the following :

For a system at stable thermodynamic equilibrium

(i) satisfy the criteria for mechanical, thermal and chemical equilibrium

(ii) there will be a transport of momentum and mass

(iii) all gradients external or internal are nonexistent

(iv) $\frac{\partial E}{\partial x} = 0 ; \frac{\partial^2 E}{\partial x^2} > 0$

(v) $\frac{\partial E}{\partial x} = 0 ; \frac{\partial^2 E}{\partial x^2} < 0$

(A) (i), (iii) and (iv)

(B) (ii), (iii) and (v)

(C) (i), (ii) and (iv)

(D) (ii), (iv) and (v)

77. In refrigeration and air conditioning, large volumes of vapour and gas are pumped using :

(A) Blowers

(B) Steam-jet ejectors

(C) Fans

(D) Centrifugal blowers

78. Match the following terms in column I with the appropriate one given in column II. :

	Column I		Column II
P.	Joule Thomson effect	I.	A = E – TS
Q.	Work function	II.	F = H – TS
R.	Gibb's free energy	III.	H remains constant
S.	Triple point	IV.	Degrees of freedom is zero

(A) P-IV, Q-I, R-IV, S-II

(B) P-I, Q-II, R-IV, S-III

(C) P-II, Q-IV, R-III, S-I

(D) P-III, Q-I, R-II, S-IV

79. Consider the following statements regarding chemical potential :

(i) It is an intensive property

(ii) For a pure substance, it increases with temperature

(iii) It is expressed in Joule/kg of the substance

(iv) It decreases when the pressure increases

Choose the correct answer from the above statements.

(A) (i) only

(B) (ii) only

(C) (i) and (iii)

(D) (i) and (ii)

80. The unit of rate constant of an n^{th} order reaction is :

(A) $(\text{concentration})^{n-1}$ (time)

(B) $(\text{concentration})^{1-n}$ / (time)

(C) concentration $\times$ $(\text{time})^{n-1}$

(D) (mole) (time)/$(\text{concentration})^{n-1}$

81. A liquid phase reaction P → Q → R, with rate constants k_1 and k_2 respectively, is conducted in a batch reactor. The time at which maximum concentration of Q can be obtained and the corresponding concentration of Q, are respectively given by :

(A) $t_{max} = \ln(k_2/k_1)/(k_2 - k_1),\ C_{Q,\,max} = C_{p_0}(k_1/k_2)^{k_2/(k_2-k_1)}$

(B) $t_{max} = \ln(k_2/k_1)/(k_2 - k_1),\ C_{Q,\,max} = C_{p_0}(k_1/k_2)^{k_1/(k_2-k_1)}$

(C) $t_{max} = \ln(k_2/k_1)/(k_2 + k_1),\ C_{Q,\,max} = C_{p_0}(k_1/k_2)^{k_2/(k_2-k_1)}$

(D) $t_{max} = \ln(k_2/k_1)/(k_2 + k_1),\ C_{Q,\,max} = C_{p_0}(k_1/k_2)^{k_1/(k_2-k_1)}$

82. Consider, a reversible reaction, $2NH_3 \leftrightarrow N_2 + 3H_2$. Select the correct statements about this reaction from the following :

p. The forward reaction is having elementary biomolecular reaction mechanism

q. Reverse reaction is elementary

r. Principle of microreversibility is applicable

s. The reaction is non-elementary

(A) p only

(B) p and q

(C) q and r

(D) s only

83. An irreversible reaction $A \rightarrow R$, is carried out in a mixed flow reactor with a space time of 2 minutes and an initial concentration of A as 5 moles/litre.The concentration of A is now increased to 10 moles/litre. The new space time is:

(A) 1 minute

(B) 2 minutes

(C) 4 minutes

(D) 8 minutes

84. According to Weisz-Prater criterion for a first order reaction when $C_{wp} << 1$:

(A) no concentration gradient exists within the pellet

(B) there are diffusion limitations

(C) the effectiveness factor decreases with increasing concentration

(D) none of the above

85. The best reactor scheme for conducting an autocatalytic reaction is :

(A) A single PFR

(B) PFR followed by MFR

(C) MFR followed by PFR

(D) A series of MFRs

86. It is proposed to remove a solute from a gas by a countercurrent operation with a liquid solvent. This operation is then conducted by absorption with chemical reaction. For this reaction, kg a=0.8mol/(h.m^3.Pa), k_1 a=25h^{-1}, H=3000(Pa.m^3)/mol where k_g and k_l is the gas and liquid film mass transfer coefficient respectively. H is the Henry's law constant.

For this reaction :

(A) The major resistance is in the gas film

(B) The major resistance is in the liquid film

(C) The major resistance is in the bulk liquid

(D) Absorption with reaction will not be helpful

87. The Baume gravity scale for liquids heavier than water is defined as :

(A) Degree Baume = $145 - \dfrac{145}{sp.\ gravity\ at\ 288\,K/288\,K}$

(B) Degree Baume = $\dfrac{145}{sp.\ gravity\ at\ 288.8\,K/288\,K} - 145$

(C) Degree Baume = $\dfrac{140}{sp.\ gravity\ at\ 288.8\,K/288\,K} - 130$

(D) Degree Baume = $\dfrac{141.5}{sp.\ gravity\ at\ 288.8\,K/288\,K} - 131.5$

88. Match the following :

a.	Cox chart	e.	Equal pressure reference substance plots
b.	Duhring plot	f.	Equal temperature reference plots
c.	Antoine equation	g.	$\frac{d \ln p^S}{dT} = \frac{\lambda}{RT^2}$
d.	Clapeyron equation	h.	$\ln P^S = A - \frac{B}{T - C}$

(A) a-f, b-h, c-e, d-e

(B) a-e, b-f, c-g, d-h

(C) a-f, b-e, c-h, d-g

(D) a-g, b-e, c-f, d-h

89. In a reaction, 50% of reactant A fed is converted to a desired product R and an undesired product S. 60% of A that converted gives R and the rest S. Then the yield and selectivity are

(A) Yield is 60% Selectivity is 1

(B) Yield is 30% Selectivity is 1.5

(C) Yield is 50% Selectivity is 1

(D) Yield is 60% Selectivity is 1.5

90. The slacking index of coal is :

(A) a measure of the clinkering tendency of the ash

(B) an indication of its size stability when stored, exposed to weather

(C) a measure of the heating value

(D) a measure of the caking and coking characteristics of the coal

91. 1000 kg of soap produced contains 40% moisture on a wet basis. Before it can be pressed into cakes for sale, the moisture should be reduced to 20%. How many 125 g cakes can be pressed from the wet soap?

(A) 6000 (B) 10000

(C) 6250 (D) 7500

92. Calorific value of a fuel is same as :

(A) Heat of combustion of a fuel

(B) Heat of formation of a fuel

(C) Negative of the heat of combustion

(D) None of the above

93. A binary distillation column separates 100 kmol/h a feed containing 40 mol% benzene and 60 mol% toluene at 101.3 kPa. It is desired to produce a distillate containing 90 mol% benzene. If a reflux ratio of 4 is used, the amount of residue is :

(A) 20 kmol/h

(B) 80 kmol/h

(C) 40 kmol/h

(D) 60 kmol/h

94. The standard heats of formation for HCl(g), NH_3(g) and NH_4Cl(g) are –92.31 kJ/mol, –46.19 kJ/mol and –314.43 kJ/mol respectively. The heat of reaction of the following reaction is :

$HCl + NH_3 \rightarrow NH_4Cl$

(A) 175.93 kJ/mol

(B) –360.55 kJ/mol

(C) –268.31 kJ/mol

(D) –175.93 kJ/mol

95. For a liquid fuel, the performance number is related to :

(A) the volatility

(B) the ignition delay

(C) the detonation tendency

(D) sulphur content

96. Match the following :

P.	Ultimate analysis	I.	Heat capacity of solids
Q.	Proximate analysis	II.	C, H_2, O_2, N_2, S, ash
R.	Trouton's ratio	III.	Heat supplied to the absolute temperature
S.	Kopp's rule	IV.	Moisture, volatile matter, fixed carbon, ash
		V.	Latent heat of vapourization to the normal boiling point

(A) P-I, Q-III, R-II, S-IV

(B) P-II, Q-IV, R-V, S-I

(C) P-IV, Q-II, R-III, S-V

(D) P-V, Q-I, R-IV, S-III

97. In paper industry, the moisture content of paper is measured by measuring :

(A) temperature

(B) thermal conductivity

(C) pressure

(D) electrical conductivity

98. Dead zone of an instrument is :

(A) a measure of the transportation lag

(B) the time required by the instrument to detect the change

(C) the largest change in variable that does not produce a change in the reading

(D) same as time constant

99. Choose the right one :

(A) Pitot tube has negligible pressure loss

(B) Moisture content is measured using hydrometer

(C) The losses in open channel is directly proportional to the velocity

(D) In a manometer the pressure at the bottom of the column depends on the diameter of the tube

100. Match the terms in column I with column II

	Column I		Column II
(i)	Fidelity	(a)	Precision
(ii)	Resistance potentiometer	(b)	Polycrystalline
(iii)	Piezoelectric transducer	(c)	Static and dynamic error
(iv)	Sensitivity	(d)	Zero order

(A) (i)-(a), (ii)-(b), (iii)-(d), (iv)-(c)

(B) (i)-(b), (ii)-(d), (iii)-(a), (iv)-(c)

(C) (i)-(c), (ii)-(a), (iii)-(b), (iv)-(d)

(D) (i)-(c), (ii)- (d), (iii)-(b), (iv)-(a)

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