

DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO

Test Booklet No. :

Series

00385

TEST BOOKLET

CHEMICAL ENGINEERING



Time Allowed : 2 Hours

Full Marks : 100

Read the following instructions carefully before you begin to answer the questions :

1. The name of the Subject, Roll Number as mentioned in the Admission Certificate, Test Booklet No. and Series are to be written legibly and correctly in the space provided on the Answer-Sheet with Black/Blue ballpoint pen.
2. Answer-Sheet without marking Series as mentioned above in the space provided for in the Answer-Sheet shall not be evaluated.
3. All questions carry equal marks.

The Answer-Sheet should be submitted to the Invigilator.

Directions for giving the answers : Directions for answering questions have already been issued to the respective candidates in the 'Instructions for marking in the OMR Answer-Sheet' along with the Admit Card and Specimen Copy of the OMR Answer-Sheet.

Example :

Suppose the following question is asked :

The capital of Bangladesh is

- (A) Chennai
- (B) London
- (C) Dhaka
- (D) Dhubri

You will have four alternatives in the Answer-Sheet for your response corresponding to each question of the Test Booklet as below :

(A) (B) (C) (D)

In the above illustration, if your chosen response is alternative (C), i.e., Dhaka, then the same should be marked on the Answer-Sheet by blackening the relevant circle with a Black/Blue ballpoint pen only as below :

(A) (B) (C) (D)

The example shown above is the only correct method of answering.

4. Use of eraser, blade, chemical whitener fluid to rectify any response is prohibited.
5. Please ensure that the Test Booklet has the required number of pages (16) and 100 questions immediately after opening the Booklet. In case of any discrepancy, please report the same to the Invigilator.
6. No candidate shall be admitted to the Examination Hall/Room 20 minutes after the commencement of the examination.
7. No candidate shall leave the Examination Hall/Room without prior permission of the Supervisor/ Invigilator. No candidate shall be permitted to hand over his/her Answer-Sheet and leave the Examination Hall/Room before expiry of the full time allotted for each paper.
8. No Mobile Phone, Electronic Communication Device, etc., are allowed to be carried inside the Examination Hall/Room by the candidates. Any Mobile Phone, Electronic Communication Device, etc., found in possession of the candidate inside the Examination Hall/Room, even if on off mode, shall be liable for confiscation.
9. No candidate shall have in his/her possession inside the Examination Hall/Room any book, notebook or loose paper, except his/her Admission Certificate and other connected papers permitted by the Commission.
10. Complete silence must be observed in the Examination Hall/Room. No candidate shall copy from the paper of any other candidate, or permit his/her own paper to be copied, or give, or attempt to give, or obtain, or attempt to obtain irregular assistance of any kind.
11. This Test Booklet can be carried with you after answering the questions in the prescribed Answer-Sheet.
12. Noncompliance with any of the above instructions will render a candidate liable to penalty as may be deemed fit.
13. No rough work is to be done on the OMR Answer-Sheet. You can do the rough work on the space provided in the Test Booklet.

N.B. : There will be negative marking @ 0.25 per 1 (one) mark against each wrong answer.

1. Portland cement consists mainly of
 - (A) CaO and SiO_2
 - (B) Al_2O_3 and Fe_2O_3
 - (C) Fe_2O_3 and CaSO_4
 - (D) CaSO_4 and Al_2O_3
2. During clinker production, the raw material is heated in a rotary kiln at approximately
 - (A) 3000°C
 - (B) 1450°C
 - (C) 750°C
 - (D) 550°C
3. The clinker is a/an
 - (A) waste product in cement production
 - (B) valuable product of biomass gasification
 - (C) product obtained after adding additives to cement
 - (D) intermediate product in cement production before adding additives to cement
4. Gypsum is a crucial mineral added to cement during grinding to
 - (A) decrease the volatility of cement
 - (B) decrease the setting rate of cement
 - (C) increase the setting rate of cement
 - (D) increase the density of cement
5. Which of the following is **not** a key constituent of cement clay?
 - (A) Silica
 - (B) Alumina
 - (C) Ammonia
 - (D) Iron oxide
6. C_3S (tricalcium silicate) is responsible for
 - (A) early strength gain of concrete
 - (B) long-term, ultimate strength of concrete
 - (C) color and sulfate resistance of cement
 - (D) rapid setting of cement
7. 18.066×10^{23} atoms of oxygen contain
 - (A) 1 mole of oxygen
 - (B) 2 moles of oxygen
 - (C) 3 moles of oxygen
 - (D) 4 moles of oxygen
8. If the specific gravity of crude oil fraction collected from a depth of 9768 ft to 9774 ft is 0.9 (at 15.6°C), what will be its API gravity?
 - (A) 32.59
 - (B) 25.72
 - (C) 27.79
 - (D) 19.30

9. "The total volume of a non-reacting gas mixture at constant temperature and pressure is the sum of the individual partial volumes each gas would occupy if it were alone under those same conditions." This is the statement of
- Amagat's law
 - Dalton's law
 - Henry's law
 - Kirchhoff's law
10. For an ideal diatomic gas, the molar specific heat at constant volume (C_v) is typically
- R
 - $2R$
 - $2.5R$
 - $3.5R$
11. 1 centipoise is equivalent to
- 0.001 Pa.s
 - 0.01 Pa.s
 - 0.01 kg/(m.s)
 - 0.001 kg/(cm.s)
12. The volume occupied by one gram mole of a gas at STP is
- 22.4 cc
 - 22.4 litres
 - 22400 litres
 - 220.4 litres
13. Which of the following is a ferromagnetic material?
- Aluminium
 - Copper
 - Cobalt
 - Lead
14. The depth of hardness of steel can be increased by the addition of
- chromium
 - nickel
 - calcium
 - tungsten
15. Which of the following metals does **not** react violently with water?
- K
 - Na
 - Ca
 - Au
16. Duralumin is an alloy of
- Al, Mg, Mn, Si
 - Al, Cu, Mg, Mn
 - Cu, Mg, Mn, Ti
 - Ca, Mg, Mn, C

17. Which element is added to improve the hardness and wear resistance of steel alloy?

- (A) Nickel
- (B) Titanium
- (C) Tungsten
- (D) Manganese

18. No cutting fluid is normally used while machining

- (A) mild steel
- (B) stainless steel
- (C) aluminium
- (D) cast iron

19. Fine-grained steels generally exhibit

- (A) higher ductility
- (B) lower strength
- (C) lower toughness
- (D) higher brittleness

20. An ideal fluid

- (A) is always compressible
- (B) obeys Newton's law of viscosity
- (C) is frictionless and incompressible
- (D) exhibits high viscosity

21. An example of dilatant fluid is

- (A) sewage sludge
- (B) rubber latex
- (C) quicksand
- (D) Both (A) and (B)

22. The Navier-Stokes equation is derived from the fundamental principle of

- (A) conservation of energy
- (B) conservation of mass
- (C) conservation of momentum
- (D) Newton's law of viscosity

23. Bernoulli's equation describes the

- (A) potential energy balance in laminar flow
- (B) mechanical energy balance in laminar flow
- (C) mechanical energy balance in boundary layer
- (D) mechanical energy balance in potential flow

24. Drag coefficient C_D , in Stokes' law range, is given by

- (A) $C_D = \text{Re}_p / 16$
- (B) $C_D = \text{Re}_p / 6$
- (C) $C_D = 16 / \text{Re}_p$
- (D) $C_D = 24 / \text{Re}_p$

25. The velocity profile for turbulent flow through a closed conduit is generally

- (A) linear
- (B) logarithmic
- (C) parabolic
- (D) hyperbolic

26. Cavitation happens when

- (A) $NPSH_{\text{available}} = 0$
- (B) $NPSH_{\text{available}} = NPSH_{\text{required}}$
- (C) $NPSH_{\text{available}} < NPSH_{\text{required}}$
- (D) $NPSH_{\text{available}} > NPSH_{\text{required}}$

[where NPSH = Net Positive Suction Head]

27. Priming is needed in a

- (A) gear pump
- (B) vane pump
- (C) centrifugal pump
- (D) reciprocating pump

28. A gear pump is used for fluids with

- (A) suspended solids
- (B) high viscosity
- (C) abrasive materials
- (D) shear-sensitive liquids

29. Which of the following produces maximum pressure difference for transportation of gases?

- (A) Reciprocating pump
- (B) Fan
- (C) Blower
- (D) Compressor

30. The Reynolds' number (Re) for pipe flow is independent of the

- (A) length of the pipe
- (B) fluid density
- (C) pipe diameter
- (D) viscosity of the fluid

31. In constant pressure filtration

- (A) resistance decreases with time
- (B) rate of filtration is constant
- (C) rate of filtration decreases with time
- (D) rate of filtration increases with time

32. The rate of filtration does **not** depend on

- (A) area of filtering surface
- (B) viscosity of the filtrate
- (C) resistance of the filter medium
- (D) density of the filtrate

33. The purpose of flocculation after coagulation is to

- (A) destabilize particles
- (B) remove organic matter
- (C) form large, settleable flocs
- (D) kill bacteria

34. The fundamental principle behind sedimentation is

- (A) centrifugal force
- (B) surface tension
- (C) distillation
- (D) gravity

35. Swirling and vortex formation in agitator can be prevented by

- (A) dissolving salt in the solvent
- (B) using baffles
- (C) using non-toxic fluid
- (D) increasing the heat transfer rate during agitation

36. Mach number is defined as

- (A) speed of sound/speed of fluid
- (B) speed of sound/rate of heat flow
- (C) speed of fluid/speed of sound
- (D) speed of fluid/rate of heat flow

37. Tertiary treatment of sewage removes

- (A) large solids
- (B) dissolved and colloidal organic matter
- (C) grease
- (D) heavy metals

38. The presence of nitrogen in a wastewater sample is due to the decomposition of

- (A) fats
- (B) carbohydrates
- (C) proteins
- (D) vitamins

39. Eutrophication of lakes is primarily caused by

- (A) increase in bacterial growth rate
- (B) excessive inflow of nutrients
- (C) increase in flow rate of water
- (D) thermal and density currents

40. Water pollution is **not** caused by

- (A) exhaust emission from internal combustion engine
- (B) oxygen demanding wastes
- (C) fertilizers used in crop field
- (D) pathogenic bacteria

41. Which of the following materials can be considered as a non-biodegradable waste?
- (A) Synthetic fiber
 - (B) Rice straw
 - (C) Wood
 - (D) Paper
42. Disinfection of water may be done by
- (A) filtration
 - (B) using chemicals like phenyl
 - (C) using ultraviolet radiation
 - (D) fractional distillation
43. Oil and grease present in an emulsified state in wastewater discharged from industries can be removed by
- (A) biological oxidation
 - (B) coagulation/flocculation (adding chemical reagents)
 - (C) chlorination
 - (D) using UV light
44. Which of the following is **not** a chemical coagulant?
- (A) Alum
 - (B) Polyaluminum chloride (PAC)
 - (C) Sulfur dioxide
 - (D) Ferric sulfate
45. Polluted water having low biochemical oxygen demand (BOD) is most economically treated using
- (A) sedimentation tank
 - (B) oxidation pond
 - (C) sludge digester
 - (D) clarifier
46. The process of lagooning is primarily a means of
- (A) disposing sludge
 - (B) increasing the capacity of storage reservoirs
 - (C) reducing the excessive flow in sewers
 - (D) increasing the flow of sewage through tanks
47. The biochemical treatment of sewage effluents is essentially a process of
- (A) polymerization
 - (B) aromatization
 - (C) oxidation
 - (D) reduction
48. Which of the following represents the physical characteristics of water?
- (A) BOD
 - (B) COD
 - (C) Turbidity
 - (D) Chloride content

49. An oxidizing agent used in COD test for samples of wastewater is

- (A) potassium dichromate
- (B) potassium chloride
- (C) potassium chromate
- (D) potassium hydroxide

50. BOD of wastewater is determined under standardized conditions, most commonly by incubating a sample in the dark at

- (A) 20 °C for 7 days
- (B) 20 °C for 5 days
- (C) 25 °C for 7 days
- (D) 25 °C for 5 days

51. Which of the following is an end product formed from both the aerobic and anaerobic decompositions of organic matter?

- (A) CH_4
- (B) CO_2
- (C) H_2S
- (D) NH_3

52. The gas from sludge digestion tank is mainly composed of

- (A) CH_4
- (B) H_2S
- (C) CO_2
- (D) CO

53. In petroleum industries, dissolved air floatation process is used for

- (A) dewatering of sludge
- (B) recovery of oil from sludge
- (C) toxic material removal from sludge
- (D) sludge thickening

54. Petroleum-bearing rocks are

- (A) igneous rocks
- (B) metamorphic rocks
- (C) sedimentary rocks
- (D) magma

55. Which of the following is a common seal or cap rock?

- (A) Shale
- (B) Igneous
- (C) Metamorphic
- (D) Trap

56. Permeability of sedimentary rock indicates

- (A) the amount of hydrocarbon present in a rock
- (B) characteristics of cap rock
- (C) properties of the traps
- (D) how easily a formation permits a hydrocarbon fluid to flow through it

57. Which of the following is **not** responsible for causing permanent hardness of water?

- (A) MgCl_2
- (B) CaSO_4
- (C) $\text{Mg}(\text{HCO}_3)_2$
- (D) MgSO_4

58. Which of the following components of petroleum drilling provides the hoisting and breaking power to lift and lower the heavy weights of drill string and casings?

- (A) Draw work
- (B) Mud pump
- (C) Kelly
- (D) Christmas tree

59. Stratigraphic trap is formed

- (A) by deformation of the beds after they were deposited, either by folding or faulting
- (B) by changes in the nature of the rocks themselves or in their layering
- (C) due to water flowing through the reservoir
- (D) partly by structural and partly by stratigraphic effects

60. The function of Kelly in hydrocarbon drilling rig is to

- (A) control the flow rate of the drilling fluid before entering into the drill string
- (B) provide a high-pressure seal
- (C) provide rotation of the drill string
- (D) provide safety line to seal a well and stop uncontrolled releases

61. Christmas tree is a/an

- (A) single cylinder CI engine system
- (B) high head turbine
- (C) electric generator
- (D) multi-valved structure

62. Which of the following is **not** a function of casing in hydrocarbon production?

- (A) It controls the formation pressure
- (B) It confines production to the wellbore
- (C) It provides an anchor for surface equipment
- (D) It accelerates the rate of fracturing of the upper and weaker zone

63. A jack-up (self-elevating) rig generally operates in water at a depth of around

- (A) 350 ft
- (B) 1300 ft
- (C) 2500 ft
- (D) 4350 ft

64. Which of the following is a floater-type drilling rig?

- (A) Leg-type
- (B) Mat-type
- (C) Semi-submersible
- (D) Jack-up

65. Limited hydrocarbon producing rate may be a result of

- (A) good reservoir permeability
- (B) excessive back pressure on formation
- (C) adequate artificial lift
- (D) sufficient reservoir pressure for depth

66. Which of the following products is typically stored in a floating roof tank?

- (A) Bitumen
- (B) Water
- (C) Liquid oxygen
- (D) Gasoline

67. Which of the following statements about fixed roof tank is correct?

- (A) Fixed roof tanks are the most expensive tanks.
- (B) Fixed roof tanks are mainly used for storing low-pressure liquids such as diesel.
- (C) The roof of fixed roof tank is in contact with the liquid surface.
- (D) The emissions from the fixed roof tank are generally less than that of floating roof tanks.

68. One of the major disadvantages of hydro-power is that

- (A) power generation is dependent on the quantity of water available which may vary from season to season and year to year
- (B) the running costs of hydro-power installation are very low as compared to thermal and nuclear power stations
- (C) the problem of emission of polluting gases and particulates to the atmosphere mostly does not exist
- (D) being simple in design and operation, the hydro-power plants do not require highly skilled workers

69. High-head hydroelectric power plants work under a head of

- (A) 100 m or above
- (B) 50 m to 100 m
- (C) 30 m to 50 m
- (D) below 30 m

70. Which turbine converts the whole pressure energy into kinetic energy first?

- (A) Kaplan turbine
- (B) Francis turbine
- (C) Propeller turbine
- (D) Pelton wheel

71. A run-of-river plant with pondage can operate

- (A) as a base-load plant
- (B) as a peak-load plant
- (C) as both base-load and peak-load plants
- (D) only during high river flow

72. Which of the following is an example of reaction turbine?

- (A) Pelton wheel
- (B) Francis turbine
- (C) Banki-Michell turbine
- (D) Turgo turbine

73. A penstock in a hydro-power plant is a

- (A) rotating machine with blades that converts the energy of moving water (potential and kinetic) into mechanical, rotational energy, which then spins a generator to produce electricity
- (B) massive barrier built across a river to create a large, elevated reservoir, storing water to provide potential energy
- (C) large pipe or conduit that carries high-pressure water from a reservoir down to the turbine for electricity generation
- (D) protective reservoir that absorbs pressure surges, preventing water hammer damage and stabilizing water flow to the turbine during rapid load changes

74. Power number refers to

- (A) drag force/inertial force
- (B) inertial force/drag force
- (C) drag force/viscous force
- (D) buoyancy force/viscous force

75. A propeller agitator with a pitch of 1.0 is said to have

- (A) linear pitch
- (B) square pitch
- (C) rectangular pitch
- (D) orthorhombic pitch

76. Kinematic viscosity is defined as the ratio of

- (A) dynamic viscosity and density
- (B) dynamic viscosity and humidity
- (C) dynamic viscosity and pressure
- (D) flow rate and pressure

77. The unit of momentum flux is

- (A) kg/m s^2
- (B) kg m/s
- (C) m^2/s
- (D) Both (B) and (C)

78. For power-law fluids, the value of n for a pseudoplastic is

- (A) $n < 1$
- (B) $n > 1$
- (C) $n = 1$
- (D) Both (B) and (C)

79. The ratio of wall shear stress to the product of density and velocity head is

- (A) skin friction
- (B) fanning friction
- (C) form friction
- (D) drag

80. In Hagen-Poiseuille flow through a cylindrical tube, the radial profile of shear stress is

- (A) constant
- (B) parabolic
- (C) linear
- (D) cubic

81. The operating principle of a Bourdon gauge is based on

- (A) thermal expansion
- (B) change in electrical resistance
- (C) elastic deformation of a curved tube
- (D) fluid column height

82. The vortex in which the energy per unit mass of the liquid is constant is

- (A) forced vortex
- (B) free vortex
- (C) natural vortex
- (D) induced vortex

83. Which type of pump is suitable for handling liquids containing solid particles?

- (A) Cam pump
- (B) Vane pump
- (C) Flexible vane pump
- (D) Both (A) and (B)

84. Corrosion is

- (A) a reversible reaction
- (B) an irreversible interfacial reaction
- (C) a non-spontaneous reaction
- (D) None of the above

85. Match the following pumps with materials :

<i>Pump</i>	<i>Material</i>
P. Screw pump	1. Cement slurries
Q. Peristaltic pump	2. Biological fluids
R. Mono pump	3. Highly viscous polymer fluids
S. Centrifugal pump	4. Gritty fluids

Select the correct answer.

- (A) P Q R S
1 2 3 4
- (B) P Q R S
3 2 4 1
- (C) P Q R S
3 2 1 4
- (D) P Q R S
4 3 2 1

86. The range of coefficient of discharge (C_d) for a venturi meter is

- (A) 0.6 to 0.7
(B) 0.7 to 0.8
(C) 0.8 to 0.9
(D) 0.95 to 0.99

87. The volumetric efficiency for a reciprocating pump varies from

- (A) 10% to 20%
(B) 40% to 50%
(C) 90% to 100%
(D) None of the above

88. Zeta potential is determined by which of the following?

- (A) Mobility of colloidal particles under an applied electric field
(B) Stability of a colloidal system
(C) Surface charge on the particles
(D) All of the above

89. Most widely used solvent for dewaxing process of lubricating oils is

- (A) naphtha
(B) sodium plumbite
(C) methyl ethyl ketone (MEK)
(D) methyl isobutyl ketone (MIBK)

90. Which type of corrosion occurs in the presence of two dissimilar metals in electrical contact?

- (A) Galvanic corrosion
(B) Pitting corrosion
(C) Crevice corrosion
(D) Stress corrosion

91. Arsenic contamination in ground-water (specially in Assam) is primarily caused by

- (A) industrial effluents
(B) coal mining
(C) reductive dissolution of iron oxyhydroxide
(D) agricultural runoff

92. Which pollutant is mostly associated with endocrine disruption in aquatic organisms?

- (A) Cadmium
(B) Bisphenol A (BPA)
(C) Sulfate
(D) Chloride

93. In the oxygen sag curve, the lowest dissolved oxygen (DO) level occurs at
- (A) pollution zone
 - (B) active decomposition zone
 - (C) recovery zone
 - (D) clean water zone
94. Low-heat cement is useful for
- (A) plastering in residential buildings
 - (B) massive structure work
 - (C) underwater construction
 - (D) construction in tropical environment
95. Which type of cement is most suitable for construction having contact with seawater?
- (A) High early strength cement
 - (B) Sulphate resistant cement
 - (C) Low-heat cement
 - (D) High-alumina cement
96. Thermal pollution in water bodies typically results in
- (A) increase in dissolved oxygen (DO)
 - (B) decrease in biochemical oxygen demand (BOD)
 - (C) decrease in dissolved oxygen (DO)
 - (D) increase in salinity
97. Fluoride contamination in ground-water is most commonly associated with
- (A) basaltic rocks
 - (B) granite rocks
 - (C) peat soils
 - (D) alluvial deposits
98. The primary purpose of agitation in liquid-liquid system is to
- (A) increase molecular diffusion
 - (B) increase interfacial area between phases
 - (C) reduce power consumption
 - (D) minimize shear rate
99. Washing of filter cake is most efficient when
- (A) channels or cracks form within the cake
 - (B) washing occurs at low flow rate
 - (C) cake is uniform and incompressible
 - (D) wash liquid has high viscosity
100. The main function of a shale shaker in the circulation system is to
- (A) remove sand sized particles
 - (B) remove very fine silt particles
 - (C) control gas entrainment
 - (D) reduce annular friction pressure

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