భారతీయ సాంకేతిక విజ్ఞాన సంస్థ హైదరాబాద్
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Advt. No. IITH/2023/Rec/NF/13
Question Paper ID: **002**

Application Number of the Candidate

Name of the Post: **Junior Technician- Chemical engineering** Pay Level: **03**

Date & Time of the Exam: 20.06.2023 Duration: 01 hr. 30 min

Scheme of the Exam: 10 AM to 11:30 AM Total Marks : 50

Topic	Number of Question	Marks
Arithmetic	05	1x5 = 5
General English	05	1x5 = 5
Work Related Topics	40	1x40 = 40

Instructions to fill the responses in the OMR answer sheet

1. Candidate must write his/her **application number** in the designated box on the top of OMR answer sheet
2. Candidate must write Question paper ID in the designated box on the top of OMR answer sheet
3. Candidate must sign in the box provided in the OMR answer sheet
4. Each answer sheet must be signed by the invigilator in the space printed in the OMR answer sheet
5. Only one response to be selected & marked. In case more than one response is marked for a single question or no response is marked for a question, no marks will be awarded for that question.
6. Partially filled circles shall not be considered as responses
7. Erasing or changing of answer is not allowed.
8. No negative marking
9. Candidate must use Blue/Black ball point pen to fill his/her responses
10. Rough work should not be done on the OMR answer sheet.
11. Candidate can use the designated page(s) of the question booklet for the purpose of rough work

Arithmetic

1. Rajeev's age after 15 years will be five times his age five years back. What is the present age of Rajeev?

    a. 12

    b. 14

    c. 22

    d. 10

2. What is the compound interest on Rs. 2500 for two years at a rate of interest of 4% per annum?

    a. Rs. 180

    b. Rs. 204

    c. Rs. 210

    d. Rs. 220

3. The speed of a boat in still water is 5 km/hr. If the boat's speed against the stream is 3 km/hr, what is the speed of the stream?

    a. 1.5 km/hr

    b. 2 km/hr

    c. 2.5 km/hr

    d. 1 km/hr

4. Two ships are sailing in the sea on the two sides of a lighthouse. The elevation angles of the top of the lighthouse observed from the ships are 30° and 45°, respectively. Find the distance between the two ships if the lighthouse is 100m high.

    a. 155.80 m

    b. 157.80 m

    c. 159.80 m

    d. 161.80 m

5. 40 % of 280 =?

   a. 112
   b. 116
   c. 115
   d. 120

General English

6. The unruly crowd demanded that the accused be _____ without trial.

   a. hanging
   b. hung
   c. hanged
   d. hankering

7. Despite the new medicine's ____ in treating diabetes, it is not ____ widely.

   a. effectiveness; prescribed
   b. availability; used
   c. prescription; available
   d. acceptance; proscribed

8. Choose the word most similar in meaning to the given the word: "Educe"

   a. Exert
   b. Educate
   c. Extract
   d. Extend

9. If the athlete had wanted to come first in the race, he _____ several hours every day.

   a. should practice
   b. should have practiced
   c. practiced
   d. should be practicing

10. What is the adverb for the word “Misogynous”?

   a. Mysogynouness
   b. Mysogynity
   c. Misogynously
   d. Misogynous

Work Related Topics

11. The stress profile for a laminar flowing through a pipe is_____.

   a. uniform
   b. linear
   c. parabolic
   d. exponential

12. If x is the distance measured from the leading edge of a flat plate, then laminar boundary layer thickness varies as

   a. x^2
   b. x^{-2}
   c. $x^{-1/2}$
   d. $x^{1/2}$

13. Surface tension is due to

   a. Cohesion only
   b. Adhesion only
   c. Cohesion and Adhesion
   d. None of the above

14. The local velocity of the fluid along a streamline can be measured by _____.

a. Pitot tube

b. Venturimeter

c. Rotameter

d. Orifice meter

15. A broken pipe ravages the basement of a house. Water needs to be pumped steadily out of a flooded basement at 5.0 m/s through a hose of radius 1.0 cm, passing through a window 3.0 m above the waterline. Estimate the power of the pump required?

a. 54 W

b. 66 W

c. 72 W

d. 80 W

16. A pump delivers 1500 L/min of water at 20°C against a pressure rise of 270 kPa. Kinetic and potential energy changes are negligible. If the driving motor supplies 9 kW what is the overall efficiency?

a. 25%

b. 50%

c. 65%

d. None of the above

17. Match the following:

A) Froude Number	1) $\frac{inertial\ force}{viscous\ force}$
B) Webber Number	2) $\frac{inertial\ force}{gravitational\ force}$
C) Euler Number	3) $\frac{pressure\ force}{inertia\ force}$
D) Reynolds Number	4) $\frac{inertial\ force}{surface\ tension\ force}$

a. A-2, B-4, C-3, D-1

b. A-3, B-4, C-2, D-1

c. A-3, B-2, C-4, D-1

d. None of the above

18. Consider that a liquid condenses on a cold plate. The condensation leads to

    a. Reduction of the temperature of the plate
    b. Increase in temperature of the plate
    c. Increase or decrease in temperature of the plate depends on the thermal conductivity of the liquid
    d. Increase or decrease in temperature of the plate depends on the thermal conductivity of the plate

19. The tea shop in a bus stand provides hot tea. Which of the following is true?

    a. The dominant mechanism of heat transfer depends on the thermal conductivity of the cup material.
    b. The dominant mechanism depends on the thermal conductivity of tea.
    c. The mechanism of heat transfer does not depend on whether the day is warm or cold.
    d. The time taken for cooling depends on the geometry of the cup.

20. We have a composite slab made of three different layers labeled 1, 2, and 3 with thermal conductivity k1 > k2 > k3. Thickness of the layers are in the ratio 1:2:3. There can 6 different arrangements of the layers from the hot to cold side indicated by (123, 132, 213, 231, 312, 321)

    a. Arrangement 231 ensures the maximum drop in the temperature of the middle layer
    b. Arrangement 132 ensures the maximum drop in the temperature in the middle layer
    c. The information provided is not sufficient to determine the arrangement that ensures the maximum drop in temperature.
    d. Drop in temperature in the layers is independent of the arrangement under steady state conditions.

21. Consider heat transfer from a wall with rectangular fins. Fin effectiveness increases with

    a. Decrease in thickness of fin
    b. Increase in thickness of fin
    c. Increase in length of the fin
    d. Is independent of length of the fin

22. In free convection

    a. The heat transfer coefficient depends explicitly on the Reynolds number.
    b. The heat transfer coefficient has a unique power law dependence on the Prandtl number.
    c. The heat transfer coefficient has a unique power law dependence on the Grashof number.
    d. The pressure gradients are significant in the boundary layer.

23. The half-life period of a first order reaction with rate constant K is given by:

    a. 1.5K
    b. 2.5k
    c. 0.693/K
    d. 6.93K

24. The molecularity of a non-elementary reaction is:

    a. Number of species as per stoichiometric relation
    b. The order as obtained from experiments
    c. Number of molecules colliding in the rate limiting step
    d. The order in the rate law

25. A reaction is considered zero order when the rate is:

    a. Directly proportional to reactant concentration
    b. Inversely proportional to reactant concentration
    c. Independent of reactant concentration
    d. None of the above

26. In an ideal tubular flow reactor:

    a. There is no mixing in the longitudinal direction
    b. Perfect mixing occurs in the radial direction
    c. Radial velocity profile is flat
    d. All of the above

27. Which of the following is true for mole balance for a reaction within a CSTR operated at steady state?

    a. Both the input and output terms are zero
    b. The input term alone is zero
    c. The accumulation term alone is zero
    d. The output term alone is zero

28. The dispersion number for a CSTR is:

    a. Infinity
    b. Zero
    c. One
    d. Negative

29. There is no correspondence between stoichiometry and rate law for a:

    a. Elementary reaction
    b. Non-elementary reaction
    c. Auto-catalytic reaction
    d. Reversible reaction

30. For very high conversion, the value of Damkohler number is:

    a. Negative
    b. Zero
    c. Very low
    d. Very high

31. Breathing process within the lungs involves:

    a. Diffusion of A through non diffusing B
    b. Equimolar counter diffusion
    c. Multi-component equimolar counter diffusion
    d. Multi-component non-equimolar counter diffusion

32. A spherical storage vessel is quarter filled with toluene. The diameter of the vent at the top of the vessel is 1/20th of the diameter of the vessel. Under the steady state condition, the diffusive flux of toluene is maximum at:

    a. The surface of the liquid
    b. The mid-plane of the vessel
    c. The vent
    d. A distance 20 times the diameter of the vent away from the vent

33. How does the mass transfer coefficient vary with the diffusivity according to the boundary layer theory?

a. $D^{1/2}$
b. $D^{1/4}$
c. $D^{1/3}$
d. $D^{2/3}$

34. The dimensionless group in mass transfer that is equivalent to Prandtl number in heat transfer is

a. Nusselt number
b. Sherwood number
c. Schmidt number
d. Stanton number

35. Desirable value of absorption factor in an absorber is

a. 1
b. <1
c. >1
d. 0.5

36. The ratio of the liquid to gas flow rate in a counter-current gas absorption column is increased at otherwise identical conditions. Which ONE of the following statements is TRUE?

a. The operating line shifts towards the equilibrium curve
b. The concentration of the absorbed species increases in the exit liquid stream
c. The operating line shifts away from the equilibrium curve
d. The operating line does not shift.

37. Distillation is the best method to separate liquids having sufficient difference in their

a. Solubility
b. Melting point
c. Boiling point
d. None of the above

38. In the McCabe Thiele diagram, If the x-coordinate of the point where the vapor-liquid equilibrium curve intersects the q line is greater than the x-coordinate of the feed point then the quality of the feed is

a. Saturated liquid
b. Saturated vapor
c. Super-heated vapor
d. Liquid below bubble point

39. The unit step response of a system is given by y(t) = 1 − exp(−2t). What is the transfer function of the system?

a. 1/(s+2)
b. 2/(s+2)
c. 2/(s+1)
d. 1/(2s+1)

40. For the data given in the previous question, what is the integral setting provided by the Ziegler-Nichols technique for PI control?

a. 2.42
b. 2.85
c. 3.42
d. 3.85

41. Consider the system $G(s) = \frac{\exp(-s)}{2s+1}$ what is the derivative setting provided by the Cohen-Coon method for PID control?

a. 0.40
b. 0.50
c. 0.55
d. 0.33

42. Consider a system described by dy/dt = y. What is the transfer function if y(0) = 1?

a. 1/(s-1)
b. 1/(s+1)
c. 1/s
d. s

43. What is the decay ratio of the second order system $G(s) = \frac{1}{s^2+s+1}$

a. 0.036
b. 0.046
c. 0.026
d. 0.056

44. The unit step response of a system is y(t) = exp(−t). What is the impulse response?

a. exp(-t)
b. exp(t)
c. -exp(t)
d. -exp(-t)

45. An irreversible first order reaction is carried out in a CSTR and PFR of equal sizes. All other conditions remaining the same, the conversion will be:

a. Higher in PFR than CSTR
b. Lower in PFR than CSTR
c. Same in PFR and CSTR
d. Independent of reactant concentration in both cases

46. Equivalent diameter of a particle is the diameter of the sphere having the same

a. ratio of surface to volume as the actual volume.
b. ratio of volume to surface as the particle.
c. volume as the particle.
d. none of these.

47. In the case of plate and frame filter press, filtrate flow through the press follows _____ flow.

a. Plug
b. Turbulent
c. Laminar
d. none of the above

48. Shape factor for a cylinder whose length equals its diameter is

a. 1.5
b. 0.5
c. 1
d. 2

49. Sedimentation in commercial scale occurs in _____.

a. Classifiers
b. Thickeners
c. Rotary drum filters
d. Cyclones

50. For coarse reduction of hard solids, use _____.

a. Impact
b. Attrition
c. Compression
d. Cutting