భారతీయ సాంకేతిక విజ్ఞాన సంస్థ హైదరాబాద్
भारतीय प्रौद्योगिकी संस्थान हैदराबाद
Indian Institute of Technology Hyderabad

Question Paper Code:

Application Number of the Candidate

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

Date & Time of the Exam: 18/12/2023   **Duration: 01 hr. 30 min**

Scheme of the Exam:

Topic	Number of Question	Marks
General English (Communication Skills)	5	1x5 = 5
General Arithmetic	5	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. Candidates must write the post code and Question paper code in the designated boxes on the top of OMR answer sheet.
3. Candidates 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. Candidates can use the designated page(s) of the question booklet for the purpose of rough work.

General English (Communication Skills):

1. Identify the segment in this sentence which contains a grammatical error "*The man played the flute and led all the mouses out of the town.*"

    a. the flute and led
    b. out of the town
    c. all of the mouses
    d. The man played

2. The meaning of "tenacious" is:
    a. Holding fast
    b. Fast running
    c. Intentional
    d. Collecting

3. Select the word with the correct spelling:
    a. Guarante
    b. Guarrantee
    c. Gurantee
    d. Guarantee

4. There was no agreement _____ the great powers _____ a treaty to ban harmful chemicals.
    a. with ; about
    b. in ; for
    c. among ; on
    d. between ; about

5. The tiles that bind us together in common activity are so _____ that they can disappear at any moment.
    a. tentative
    b. tenuous
    c. consistent
    d. restrictive

Quantitative Aptitude:

6. A 9′ x 15′ room was enlarged to 11′ x 20′. How many square feet of floor space were added?
    a. 70 sq ft
    b. 75 sq ft
    c. 80 sq ft
    d. 85 sq ft

7. If two-thirds of a person's weekly income is Rs 480, what is one-fourth of their weekly income?
    a. Rs 165
    b. Rs 180
    c. Rs 240
    d. Rs 280

8. Person A can file 50 letters in 10 minutes. Person B can file 40 letters in the same amount of time. How many letters will the two of them file in 9 hours?
    a. 4860
    b. 4870
    c. 4950
    d. 4980

9. A block of metal which weights 60 N in air and 40 N underwater has a density approximately of:
    a. 1000 kg/m^3
    b. 4000 kg/m^3
    c. 3000 kg/m^3
    d. 5000 kg/m^3

10. If a car is running at a speed of 72 km/hr and stops after 45 seconds, then what will be the retardation?
    a. 0.3 m/s^2
    b. 0.44 m/s^2
    c. 0.25 m/s^2
   d. 3 m/s^2

Work related Topics:

11. The velocity profile for a turbulent flowing fluid through a pipe is_____
    a. uniform
    b. linear
    c. parabolic
    d. none of the above

12. A garden hose with an internal diameter of 1.9 cm is connected to a (stationary) lawn sprinkler that consists merely of a container with 24 holes, each 0.13 cm in diameter. If the water in the hose has a speed of 0.91 m/s, at what speed does it leave the sprinkler holes?
    a. 7.9 m/s
    b. 8.0 m/s
    c. 8.1 m/s
    d. 8.2 m/s

13. For the same efficiency and operational speed, the volumetric flow rate for 2 pumps scales with diameter as _____ and for the same efficiency and operational speed the volumetric flow rate 2 pumps varies with operating speed _____

    a. $\frac{Q_1}{Q_2} = \frac{\omega_2}{\omega_1}$ and $\frac{Q_1}{Q_2} = \frac{D_1^3}{D_2^3}$

    b. $\frac{Q_1}{Q_2} = \frac{\omega_2}{\omega_1}$ and $\frac{Q_1}{Q_2} = \frac{D_2^3}{D_1^3}$

    c. $\frac{Q_1}{Q_2} = \frac{\omega_1}{\omega_2}$ **and** $\frac{Q_1}{Q_2} = \frac{D_1^3}{D_2^3}$

    d. $\frac{Q_1}{Q_2} = \frac{\omega_2}{\omega_1}$ and $\frac{Q_1}{Q_2} = \frac{D_2^3}{D_1^3}$

14. For the same velocity fluid flowing through a valve which of the statements for head loss is true?

    a. h_L(fully open gate valve) < h_L(fully open angle valve) < h_L(fully open ball valve)

    b. h_L(fully open gate valve) > h_L(fully open angle valve) > h_L(fully open ball valve)

    c. h_L(fully open gate valve) < h_L(fully open angle valve) ~ h_L(fully open ball valve)

    d. None of the above

15. A certain axial flow pump has a specific speed of $N_s = 5.0$. If the pump is expected to deliver 3000 gpm when operating against a 15-ft head, at what speed should the pump run? Use $g = 9.81 \ m/s^2$

    a. 1600 rpm

    b. 1900 rpm

    c. 2200 rpm

    d. 2500 rpm

16. Water at 20°C ($\rho = 998 \ \frac{Kg}{m^3}$) flows through an inclined 8-cm-diameter pipe. At sections A and B, $P_A = 186$ kPa, $V_A = 3.2$ m/s, $z_A = 24.5$ m, while $P_B = 260$ kPa, $V_B = 3.2$ m/s, and $z_B = 9.1$ m. The waters flows from _____ and the head loss is_____.

    a. A to B, 10.22 m

    b. B to A, 10.22 m

    c. A to B, 7.84 m

    d. B to A, 7.84 m

17. A, B, C are points in a water bottle as shown in the figure and P_A, P_B and P_C are the pressure at points A,B and C respectively. Which of the below statements are true?

    a. $P_A = P_B, P_A > P_C$

    b. $P_A \neq P_B, P_A > P_C$

    c. $P_A = P_B, P_A < P_C$

    d. $P_A \neq P_B, P_A < P_C$
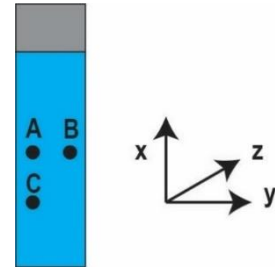
18. A pump delivers gasoline at 20°C and 12 m³/h. At the inlet, $p_1 = 100$ kPa, $z_1 = 1$ m, and $V_1 = 2$ m/s. At the exit $p_2 = 500$ kPa, $z_2 = 4$ m, and $V_2 = 3$ m/s. How much power is required if the motor efficiency is 75%? $\left(\rho g = 6671 \ \frac{N}{m^3} \right)$

    a. 1670

   b. 1870

    c. 2070

    d. 2270

19. The energy consumed in size reduction is proportional to the area of new surface produced is related which grinding law

    a. Bond's Law

    b. Rittinger's Law

    c. Kick's Law

    d. None of the above

20. What is sphericity of cuboid whose length, breadth, and depth are in the ratio of 3:2:1

    a. 0.87

    b. 0.81

    c. 1.0

    d. 0.73

21. For effective grinding, the ball mills are usually operated between what ranges of percentage of the critical speed?

    a. 70-90

    b. 30-50

    c. 40-80

    d. 50-75

22. A sand mixture was screened through a standard 10-mesh screen. The mass fraction of the oversize material in feed, overflow and underflow were found to be 0.38, 0.79 and 0.22 respectively. The screen effectiveness based on the oversize is

    a. 0.5

    b. 0.68

    c. 0.58

    d. 0.62

23. Which of the following shapes has the highest shape factor?

    a. Cylinder

b. Cube

c. Hemisphere

d. Sphere

24. The successive opening in the Taylor series of screen is with a constant ratio of

    a. 2

    b. $(2)^{\frac{1}{2}}$

    c. $(2)^{\frac{1}{3}}$

    d. $(2)^{\frac{1}{4}}$

25. Arrange the following size reduction equipment in the decreasing order of the average particle size produced by each of them

    a. Ball mills, Jaw crusher, fluid energy mills

    b. Jaw crusher, Ball mills, fluid energy mills

    c. Fluid energy mills, jaw crusher, ball mills

    d. Fluid energy mills, ball mills, jaw crusher

26. In constant pressure filtration, the rate of filtration follows the relation (V=filtrate volume, t=time, and C=constant)

    a. $\frac{dV}{dt} = kV + C$

    b. $\frac{dV}{dt} = \frac{1}{kV+C}$

    c. $\frac{dV}{dt} = kV$

    d. $\frac{dV}{dt} = kV^2$

27. 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

28. What is the transfer function between the S_1 and the S_4? (**refer to the block diagram**)

a. $\dfrac{1}{S+2}$

b. $\dfrac{0.5}{S+1}$

c. 0.5

d. $\dfrac{2}{S+1}$
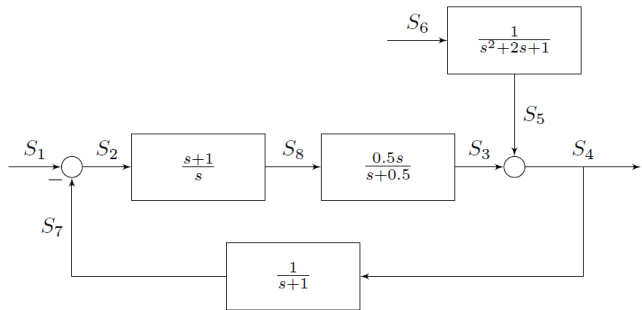
29. Given step changes in both S_6 and S_1 what is the steady state value of S_4? (**refer to the block diagram**)

a. 1.5

b. 2.0

c. 2.5

d. 1.25

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

a. $\dfrac{1}{S+2}$

b. $\dfrac{2}{S+2}$

c. $\dfrac{2}{S+1}$

d. $\dfrac{1}{2S+1}$

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

a. Number of participating species as per reaction equation

b. The power to which the reactant species are raised in the rate law

c. Number of molecules colliding in the rate limiting step

d. The coefficient in the rate law

32. In heterogenous reactions, a catalyst:

    a. Can either increase or decrease the speed of a chemical reaction

    b. Alters the value of the equilibrium constant in a reversible chemical reaction

    c. Always increases the speed of the reaction

    d. Always decreases the speed of the reaction

33. Which of the following describes temperature dependence of rate constant?

    a. Le Chatlier's equation

    b. Gibbs-Duhem equation

    c. Arrhenius equation

    d. None of the above

34. For a negative order reaction, with all other conditions remaining the same, highest conversion is achieved in:

    a. Batch reactor

    b. Continuous stirred tank reactor

    c. Plug flow reactor

    d. Fluidized bed reactor

35. The dispersion coefficient for an ideal plug flow reactor is:

    a. 1

    b. 0

    c. Infinity

    d. None of the above

36. The area under the curve of exit age distribution integrated between $t = 0$ and infinity is:

    a. 1

    b. 2

    c. 0

    d. Infinity

37. Increase in temperature for an endothermic reaction:

  a. Does not affect equilibrium conversion

  b. Initially decreases and then increases equilibrium conversion

  c. Decreases equilibrium conversion

  d. Increases equilibrium conversion

38. An ideal continuous stirred tank reactor assumes:

  a. Instantaneous reaction upon feed entry

  b. Perfect mixing within the reactor vessel

  c. No radial dispersion

  d. No axial dispersion

39. In 2-D heat transfer problems in absence of a source inside the domain of interest:

  a. If the temperature boundary conditions are specified, then a temperature discontinuity is expected in at least two corners.

  b. If the temperature boundary condition is replaced by a flux condition the general solution would remain unaffected.

  c. Superposition solutions are used when the temperature is varying on one of the edges

  d. The individual solutions in the superposition do not satisfy the boundary conditions.

40. 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.

41. In analysis of thermal radiation:

  a. Predominant wavelength of emission decreases with increase in temperature

b. The relationship between reflected and incident light is essential for calculating the radiant flux.

c. The emissivity and absorptivity are strong functions of intensity of radiation.

d. Both (a) and (b)

42. The heat transfer rate depends on

a. Variation of material properties with the temperature in conduction.

b. Absolute temperature of the material.

c. Both (a) and (b)

d. Variation of thermal properties of the surrounding environment in forced convection.

43. Consider the transient heat conduction through a slab:

a. Evolution to steady state is faster in materials with high thermal diffusivity.

b. When the internal resistance to heat transfer is high the film heat transfer coefficient decreases with time.

c. Both (a) and (b)

d. None of the above

44. For heat transfer in systems involving macroscopic flow which of the following statements hold true:

a. Continuity equation is a consequence of principle of conservation of mass

b. Transport theorem applied to control volumes moving along with the fluid gives rise to material derivative term

c. Both (a) and (b)

d. None of the above

45. Component A is diffusing in a medium B. The flux NA relative to stationary points is equal to the flux due to molecular diffusion if

a. Diffusion of A is in stagnant medium B

b. Mass transfer is accompanied by reaction

c. Molecular mean free path is high

d. There is equimolar counter-diffusion

46. A pure drug is administered as a sphere and as a cube. The amount of drug is the same in the two tablets. Assuming that the shape and size do not influence the mass transfer, the ratio of the rate of dissolution in water at t=0 for the cubic to spherical tablet is

a. 0.54

b. 1.04

c. 1.24

d. 1.9

47. Species A is diffusing at steady state from the surface of a sphere (radius = 1 cm) into a stagnant fluid. If the diffusive flux at a distance $r = 3$ cm from the center of the sphere is 27 mol/cm^2 s, the diffusive flux (mol/cm^2 s) at a distance $r = 9$ cm is

a. 1

b. 3

c. 9

d. 27

48. In the McCabe-Thiele diagram, if the x-coordinate of the point of intersection of the q–line and the vapor-liquid equilibrium curve is greater than the x-coordinate of the feed point, then the quality of the feed is:

a. Superheated vapour

b. Saturated vapour

c. Saturated liquid

d. Liquid below bubble point

49. 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 toward the equilibrium curve

b. The operating line shifts away from the equilibrium curve

c. The concentration of the absorbed species increases in the exit liquid stream

d. The operating line does not shift

50. Which ONE of the following statements is CORRECT for the surface renewal theory?

a. Mass transfer takes place at steady state

b. Mass transfer takes place at unsteady state

c. Contact time is the same for all the liquid elements

d. Mass transfer depends only on the film resistance