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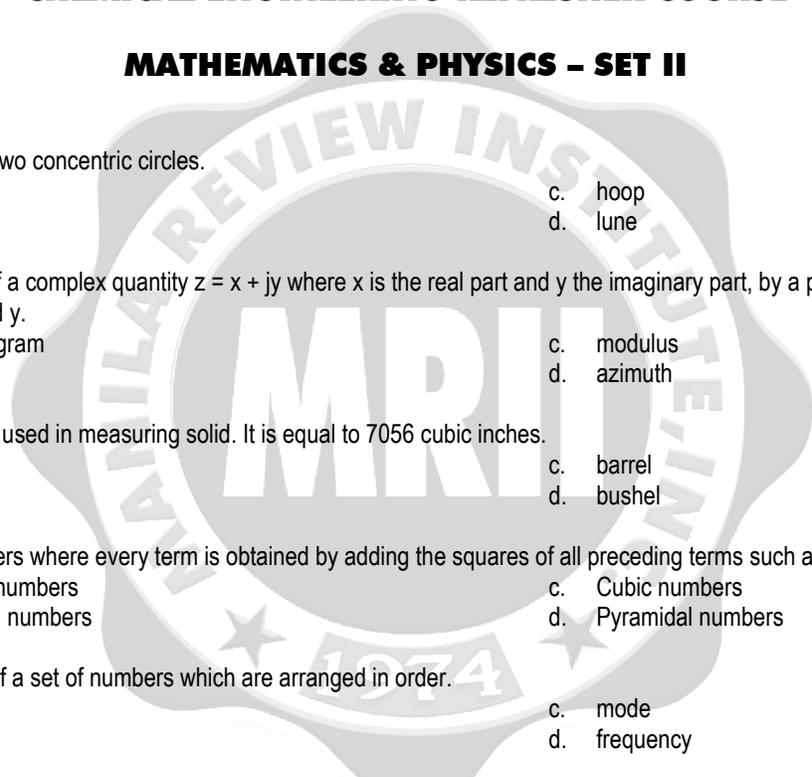**Tel. No. 8-736-MRII (6744)**
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CHEMICAL ENGINEERING REFRESHER COURSE

MATHEMATICS & PHYSICS – SET II

1. The region between two concentric circles.
   - a. ring
   - b. annulus
   - c. hoop
   - d. lune

2. The representation of a complex quantity $z = x + jy$ where x is the real part and y the imaginary part, by a point P whose Cartesian coordinates are x and y.
   - a. Argand diagram
   - b. argument
   - c. modulus
   - d. azimuth

3. A US unit of capacity used in measuring solid. It is equal to 7056 cubic inches.
   - a. gallon
   - b. barn
   - c. barrel
   - d. bushel

4. A sequence of numbers where every term is obtained by adding the squares of all preceding terms such as (1, 5, 14, 30, 55…).
   - a. Triangular numbers
   - b. Tetrahedral numbers
   - c. Cubic numbers
   - d. Pyramidal numbers

5. The middle number of a set of numbers which are arranged in order.
   - a. mean
   - b. median
   - c. mode
   - d. frequency

6. The angle formed on the outside of a plane figure between the extension of one straight edge beyond a vertex and the outer side of the other straight edge at that vertex.
   - a. interior angle
   - b. exterior angle
   - c. critical angle
   - d. reflex angle

7. One of the set of points that divide a set of data arranged in numerical order into 4 parts.
   - a. quartile
   - b. decile
   - c. percentile
   - d. quintile

8. The formation of a new wave pattern where two or more incident waves pattern overlap.
   - a. Doppler effect
   - b. interference
   - c. beat
   - d. dispersion

9. Another name of streamline flow.
   - a. turbulent flow
   - b. electron flow
   - c. laminar flow
   - d. cash flow

10. It states that a body which is wholly or partially immersed in fluid is acted on by an upward force equal to the weight of the fluid displaced.
    a. Snell's Law
    b. Archimedes' principle
    c. Bernoulli's principle
    d. Superposition theorem

11. The 18th and 52nd terms of an arithmetic progression are 3 and 173 respectively. Find the sum from the 11th term to the 50th term.
    a. 2480
    b. 2520
    c. 2580
    d. 2620

12. Solve for the value of x in the equation : $3^{3x} = 9^{(x+2)}$.
    a. 2
    b. 3
    c. 4
    d. 5

13. If $x^3 + 3x^2 + (2k + 5)x + 2 - k$ is divided by $x + 1$ and the remainder is 8, solve for k.
    a. -2
    b. -3
    c. -4
    d. -5

14. Find the z-intercept of the plane that passes through the points (2, 3, 6), (4, -2, 2), and (-6, -11, 5)
    a. -6
    b. 12
    c. -12
    d. 6

15. The difference of the cubes of two positive numbers is 2906 and the cube of their difference is 8. Find the larger number.
    a. 21
    b. 23
    c. 25
    d. 27

16. Separate 132 into 2 parts such that the larger divided by the smaller, the quotient is 6 and the remainder is 13. What is the larger number?
    a. 111
    b. 113
    c. 115
    d. 117

17. A jogger starts a course at a steady rate of 8 kph. Five minutes later, a second jogger starts the same course at 10 kph. How long will it take the second jogger to catch the first?
    a. 20 min
    b. 21 min
    c. 22 min
    d. 18 min

18. A trapezoid has an area of 180 sq cm and altitude of 20 cm. Find the shorter base if the ratio of the bases is 4 : 5.
    a. 6 cm
    b. 8 cm
    c. 10 cm
    d. 12 cm

19. Determine A if sin 2A = x and sin A = 2x.
    a. 45.52°
    b. 55.52°
    c. 65.52°
    d. 75.52°

20. A clock has dial face 10 inches in radius. The minute hand is 8 inches long while the hour hand is 6 inches long. The plane of rotation of the minute hand is 2 inches above the plane of the hour hand. Find the distance between the tips of the hands of the clock at 5:40 PM.
    a. 9.17 in
    b. 8.43 in
    c. 7.92 in
    d. 8.95 in

21. What is the distance between the centers of the circles $X^2 + Y^2 + 2X + 6Y - 3 = 0$ and $X^2 + Y^2 - 8X - 6Y + 7 = 0$
    a. 7.0 units
    b. 7.5 units
    c. 7.8 units
    d. 8.5 units

22. Transform the polar equation $r^2 \sin \theta \cos \theta = 9$ into an equation in Cartesian coordinates.
    - a. $x + y = 9$
    - b. $x^2 + y^2 = 9$
    - c. $x^2 - y^2 = 9$
    - d. $xy = 9$

23. Find the area of the triangle which the line $4x - 3y + 24 = 0$ forms with the coordinate axes.
    - a. 20 sq. units
    - b. 18 sq. units
    - c. 24 sq. units
    - d. 30 sq. units

24. In how many ways can 8 persons be seated in a row if a certain couple must not be together?
    - a. 30,240
    - b. 14,440
    - c. 32,600
    - d. 28,880

25. 2 red books, 3 yellow books, and 4 blue books are placed at random on a shelf. What is the probability that the blue books to be together?
    - a. 2/9
    - b. 1/12
    - c. 1/21
    - d. 1/210

26. Two cards are drawn at random on an ordinary deck of cards. What is the probability of getting an ace and a face card?
    - a. 16/169
    - b. 8/221
    - c. 20/221
    - d. 17/52

27. Find the slope of the equation $y = (x^6 + 3x^2 + 50) / (x^2 + 2)$ when $x = 2$.
    - a. 21
    - b. –21
    - c. 20
    - d. –20

28. Find the slope of the equation $r = \sin \theta$ when $\theta = \pi/3$.
    - a. 5.2
    - b. –5.2
    - c. 1.73
    - d. –1.73

29. A sheet of copper, which is 12 m on a side, is to be made into an open box of maximum volume. Calculate the side of the squares that should be cut out of the corners.
    - a. 1.5 m
    - b. 1.75 m
    - c. 2 m
    - d. 2.25 m

30. A police car is 20 ft away from a long straight wall. Its beacon, rotating 0.75 revolution per second, shines a beam of light on the wall. How fast is the beam moving when it is closest to the police car?
    - a. 20π ft/s
    - b. 30π ft/s
    - c. 40π ft/s
    - d. 50π ft/s

31. The height of a right circular cylinder is 50 inches and decreases at a rate of 6 inches per second while the radius of the base is 20 inches and increases at the rate of 1.5 inch per second. At what rate is the volume changing in cubic inches per second?
    - a. 500π
    - b. 600π
    - c. 750π
    - d. 900π

32. Find the area bounded by the parabola $x^2 = 12 (y - 2)$ and its latus rectum.
    - a. 24 sq. units
    - b. 30 sq. units
    - c. 36 sq. units
    - d. 48 sq. units

33. What is the area bounded by the curve $y = x^4$, the x-axis, and the line $x = 2$?
    - a. 2.4 sq. units
    - b. 4.2 sq. units
    - c. 5.2 sq. units
    - d. 6.4 sq. units

34. Find the coordinate of the centroid of area bounded by the curves $x^2 = 6y$ and $y^2 = 6x$.
    - a. (2.85, 2.85)
    - b. (2.5, 2.5)
    - c. (2.7, 2.7)
    - d. (3, 3)

35. Find the moment of inertia of the area bounded by the curve $x^2 = 3y$, the line $x = 3$ and the x-axis on the first quadrant with respect to the x-axis.
    a. 3.86
    b. 3.12
    c. 1.52
    d. 2.62

36. A public health report states that t weeks after the outbreak of a new strain of flu, the number of people, in thousands, who will contract the disease is $Q(t) = \dfrac{10}{1 + 100\, e^{-1.5t}}$. At what rate did people contract the disease after three weeks in people per week?
    a. 2089
    b. 2592
    c. 3185
    d. 3740

37. A tank contains 40 gallons of pure water. A brine solution with 2 lb/ gallon of salt enters at 2 gpm, and the well-stirred mixture leaves at the same rate. Find the time at which the brine leaving will contain 1 lb/gallon of salt.
    a. 11.33 min
    b. 12.73 min
    c. 13.86 min
    d. 14.67 min

38. Evaluate : $dy/dx = 2y / x$ at $x = 2$; $y = 2$
    a. $y = \frac{1}{2} x^2$
    b. $y = x^2 - 2$
    c. $x^2 + 2y^2 = -12$
    d. $x^2 + 2y^2 = 12$

39. Solve the differential equation whose general solution is $y = C_1 e^{-2x} + C_2 e^{3x}$.
    a. $y'' + 5 y' + 6y = 0$
    b. $y'' + y' - 6y = 0$
    c. $y'' - 5 y' + 6y = 0$
    d. $y'' - y' - 6y = 0$

40. Determine the laplace transform of sin 4t.
    a. $s/(s^2 - 16)$
    b. $s/(s^2 + 16)$
    c. $4/(s^2 - 16)$
    d. $4/(s^2 + 16)$

41. A man fires a gun and hears an echo 3 seconds later. How far is the reflecting surface if air temperature is 30° C?
    a. 500 m
    b. 525 m
    c. 550 m
    d. 575 m

42. What is the temperature in °C of 2 liters of water at 27 °C after 15,000 calories of heat have been added?
    a. 30.5
    b. 34.5
    c. 37.5
    d. 40.5

43. A 4-m string is driven by a 240 Hz vibrator at its end. Determine the speed of transverse waves on the string if it resonates five segments.
    a. 336 m/s
    b. 360 m/s
    c. 384 m/s
    d. 420 m/s

44. A dough nut 2.5 inches in diameter is placed 24 inches from a converging lens whose focal length is 16 inches. What is the type and size of the image?
    a. 6 inches, erect
    b. 6 inches, inverted
    c. 5 inches, erect
    d. 5 inches, inverted

45. The resistance of a wire is 120 ohms at 90° C and 100 ohms at 30° C. Determine the temperature coefficient of resistance at 0° C?
    a. 0.0037
    b. 0.0045
    c. 0.0052
    d. 0.0064

46. Find the approximate depth of water in a lake such that an air bubble, upon reaching the surface has a volume twice than it had at the bottom of the lake.
    a. 10.33 m
    b. 13.85 m
    c. 18.25 m
    d. 20.65 m

47. Find the fundamental frequency of a closed pipe with a length of 1.25 m at 30° C.
    a. 35 Hz
    b. 45 Hz
    c. 140 Hz
    d. 70 Hz

48. A planoconcave lens has one plane surface and one concave surface. If the planoconcave lens of refractive lens power of –20 diopter is to be ground from optical glass of index of refraction 1.5, find the radius of curvature of the surface.
   a.   –5 cm
   b.   –10 cm
   c.   -7.5 cm
   d.   -2.5 cm

49. An electric iron draws a current of 15 A at 240 V. It is desired to reduced the current to 12 A by connecting a series rheostat. What is the resistance of the rheostat?
   a.   2 ohm
   b.   3 ohm
   c.   4 ohm
   d.   5 ohm

50. An asset is purchase for P 500,000 with an economic life of 10 years. What is total accumulated depreciation in the first three years using double declining balance method?
   a.   P 236,000
   b.   P 244,000
   c.   P 256,000
   d.   P 264,000

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