SECTION : PHYSICS

This section contains **15 Multiple Choice Questions**. Each question has four choices (1), (2), (3) and (4) out of which **ONLY ONE** is correct.

1. Which of the following pairs does NOT have the same dimensions?
(1) Impulse and momentum
(2) Work and torque
(3) Frequency and angular momentum
(4) Pressure and energy density

2. A projectile is launched at 20 m/s at 60° to the horizontal (g = 10 m/s²). Its maximum height is:
(1) 10 m
(2) 15 m
(3) 20 m
(4) 30 m

3. A 5 kg block on a rough horizontal surface (μ = 0.2) is pulled by a horizontal force of 20 N. Its acceleration is (g = 10 m/s²):
(1) 1 m/s²
(2) 2 m/s²
(3) 3 m/s²
(4) 4 m/s²

4. A pump lifts 600 kg of water per minute from a 10 m deep well and ejects it with negligible speed. Taking 100% efficiency and g = 10 m/s², the power required is:
(1) 600 W
(2) 1000 W
(3) 1500 W
(4) 6000 W

5. A 60 kg man stands at one end of a 120 kg boat of length 6 m floating at rest on still water. He walks to the other end. Ignoring water resistance, the boat moves through:
(1) 1 m
(2) 3 m
(3) 2 m
(4) 4 m

6. A skater spinning with angular velocity ω pulls in her arms so that her moment of inertia becomes half. Her rotational kinetic energy:
(1) becomes half
(2) remains the same
(3) doubles
(4) becomes four times

7. Two planets orbit the same star with orbital radii in the ratio 1 : 4. The ratio of their time periods is:
(1) 1 : 2
(2) 1 : 4
(3) 1 : 8
(4) 1 : 16

8. A soap bubble of radius 2 cm is formed from a solution of surface tension 0.03 N/m. The

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excess pressure inside the bubble is:
(1) 1.5 Pa
(2) 3 Pa
(3) 6 Pa
(4) 12 Pa

9. Two moles of a monatomic ideal gas are heated at constant pressure through 10 K. The heat supplied is:
(1) 25R
(2) 20R
(3) 50R
(4) 30R

10. If the pressure of a gas is doubled at constant temperature, its mean free path:
(1) doubles
(2) halves
(3) remains the same
(4) becomes one-fourth

11. A particle in SHM has amplitude 4 cm and time period 2 s. Its speed at a displacement of 2 cm from the mean position is:
(1) 2π cm/s
(2) $2\sqrt{3}\pi$ cm/s
(3) 4π cm/s
(4) $4\sqrt{3}\pi$ cm/s

12. A source of frequency 500 Hz moves towards a stationary observer at 30 m/s. If the speed of sound is 330 m/s, the observer hears a frequency of:
(1) 455 Hz
(2) 550 Hz
(3) 500 Hz
(4) 600 Hz

13. A wire of resistance R is uniformly stretched to three times its original length. Its new resistance is:
(1) 3R
(2) 6R
(3) 9R
(4) R/3

14. A battery of emf 12 V and internal resistance 3 Ω is connected to a variable external resistor. The maximum power delivered to the resistor is:
(1) 6 W
(2) 24 W
(3) 48 W
(4) 12 W

15. A ball is dropped from a height of 20 m onto the floor. If the coefficient of restitution is 0.5, the height reached after the first bounce is:
(1) 10 m
(2) 15 m
(3) 2.5 m

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SECTION : CHEMISTRY

This section contains **15 Multiple Choice Questions**. Each question has four choices (1), (2), (3) and (4) out of which **ONLY ONE** is correct.

16. 10 g of $CaCO_3$ (molar mass 100 g/mol) is added to 100 mL of 1 M HCl. What volume of CO_2 is evolved at STP?
(1) 2.24 L
(2) 1.12 L
(3) 0.56 L
(4) 4.48 L

17. Which transition in the He+ ion emits radiation of the same wavelength as the n = 2 to n = 1 transition in the hydrogen atom?
(1) n = 3 to n = 1
(2) n = 4 to n = 2
(3) n = 3 to n = 2
(4) n = 5 to n = 3

18. Which is the correct increasing order of first ionisation enthalpy?
(1) Be < B < C < N < O
(2) B < Be < C < O < N
(3) B < Be < C < N < O
(4) Be < B < N < C < O

19. Consider O^{2+}, O_2, O^{2-} and O_2^{2-}. Which statement is correct?
(1) O^{2+} is paramagnetic and has a shorter bond length than O_2
(2) O_2^{2-} is paramagnetic with bond order 1
(3) O^{2-} is diamagnetic with bond order 2
(4) O_2 is diamagnetic with bond order 2

20. Equal masses of CH_4 and O_2 are placed in an empty rigid container at 300 K. What fraction of the total pressure is exerted by O_2?
(1) 1/2
(2) 1/3
(3) 2/3
(4) ¼

21. For $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$, $\Delta H = -92$ kJ at 298 K. What is ΔU? (R = 8.314 J/K/mol)
(1) –97.0 kJ
(2) –87.0 kJ
(3) –92.0 kJ
(4) –89.5 Kj

22. PCl_5 is 50% dissociated at a total equilibrium pressure of 3 atm: $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$. What are Kp and the degree of dissociation when the equilibrium pressure is raised to 12 atm at the same temperature?
(1) Kp = 1 atm, $\alpha \approx 0.28$
(2) Kp = 1 atm, $\alpha = 0.25$
(3) Kp = 3 atm, $\alpha \approx 0.28$
(4) Kp = 0.5 atm, $\alpha = 0.50$

23. 50 mL of 0.2 M CH3COOH is mixed with 50 mL of 0.1 M NaOH. Then 10 mL of 0.1 M HCl is added. What is the final pH? (pKa = 4.74, log 1.5 = 0.18)
(1) 4.56
(2) 4.92
(3) 4.74
(4) 3.90

24. How many moles of $KMnO_4$ are needed to completely oxidise 1 mole of $FeC2O_4$ in

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acidic medium?
(1) 0.2
(2) 0.4
(3) 0.6
(4) 1.0

25. Which statement correctly describes the trend down Group 2 (Be to Ba)?
(1) Thermal stability of carbonates and solubility of sulphates both decrease
(2) Thermal stability of carbonates and solubility of sulphates both increase
(3) Thermal stability of carbonates increases, while solubility of sulphates decreases
(4) Thermal stability of carbonates decreases, while solubility of hydroxides decreases

26. What is the total number of isomers (structural + geometrical) possible for C_4H_8?
(1) 4
(2) 5
(3) 6
(4) 7

27. Alkene A (C_5H_{10}) on ozonolysis (Zn/H_2O) gives acetone and acetaldehyde. What is the major product when A reacts with HBr in the presence of peroxide?
(1) 2-Bromo-2-methylbutane
(2) 2-Bromo-3-methylbutane
(3) 1-Bromo-3-methylbutane
(4) 1-Bromo-2-methylbutane

28. Liquids A and B form an ideal solution. At a given temperature, $p°A = 200$ mmHg and $p°B = 100$ mmHg. At what mole fraction of A in the liquid will the vapour contain A and B in equal mole fractions?
(1) 1/2
(2) 1/3
(3) 2/3
(4) 1/4

29. Which is the correct order of acidic strength?
(1) p-nitrophenol > phenol > p-cresol > ethanol
(2) phenol > p-nitrophenol > p-cresol > ethanol
(3) p-nitrophenol > p-cresol > phenol > ethanol
(4) ethanol > p-cresol > phenol > p-nitrophenol

30. Consider these statements:
I. Sucrose does not reduce Tollens' reagent because both anomeric carbons are involved in the glycosidic bond.
II. Denaturation of a protein breaks its peptide bonds and destroys its primary structure.
III. Cellulose consists of β-D-glucose units linked through C1–C4 glycosidic bonds.
IV. DNA contains ribose sugar and uracil.
Which statements are correct?
(1) I and III only
(2) I, II and III
(3) II and IV only
(4) III and IV only

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SECTION : MATHEMATICS

This section contains **20 Multiple Choice Questions**. Each question has four choices (1), (2), (3) and (4) out of which **ONLY ONE** is correct.

31. In a survey of 200 students, 120 like tea, 90 like coffee and 40 like both. The number of students who like neither tea nor coffee is
(1) 20
(2) 30
(3) 40
(4) 50

32. The number of symmetric relations on the set A = {1, 2, 3} is
(1) 8
(2) 16
(3) 64
(4) 512

33. The value of $\sin 10^\circ \cdot \sin 30^\circ \cdot \sin 50^\circ \cdot \sin 70^\circ$ is
(1) 1/32
(2) 1/8
(3) 1/16
(4) 1/4

34. The number of solutions of $2\sin^2 x - 3\sin x + 1 = 0$ in the interval $[0, 2\pi]$ is
(1) 2
(2) 3
(3) 4
(4) 5

35. If a complex number z satisfies $|z - 3 - 4i| \leq 2$, then the minimum value of $|z|$ is
(1) 2
(2) 5
(3) 3
(4) 7

36. If α and β are the roots of $x^2 - 3x + 1 = 0$, then $\alpha^4 + \beta^4$ is equal to
(1) 45
(2) 49
(3) 51
(4) 47

37. The number of integers x satisfying $|2x - 3| \leq 5$ is
(1) 5
(2) 7
(3) 6
(4) 8

38. The number of distinct arrangements of all the letters of the word MATHEMATICS is
(1) 39916800
(2) 4989600
(3) 19958400
(4) 9979200

39. A committee of 3 is to be formed from 5 men and 4 women such that at least one woman is included. The number of ways is
(1) 84
(2) 64
(3) 80
(4) 74

40. The term independent of x in the expansion of $(x^2 - 1/x)^9$ is
(1) −84
(2) 84
(3) 126
(4) 36

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41. The sum of the first n terms of an AP is $3n^2 + 5n$. The 20th term of the AP is
(1) 120
(2) 118
(3) 122
(4) 125

42. The value of $1\cdot2 + 2\cdot3 + 3\cdot4 + \ldots + 10\cdot11$ is
(1) 385
(2) 330
(3) 550
(4) 440

43. The equation of the line passing through (2, 3) and perpendicular to the line $3x - 2y + 5 = 0$ is
(1) $2x + 3y - 13 = 0$
(2) $3x + 2y - 12 = 0$
(3) $2x - 3y + 5 = 0$
(4) $3x - 2y = 0$

44. The eccentricity of the ellipse $x^2/25 + y^2/16 = 1$ is
(1) 4/5
(2) 3/5
(3) 9/25
(4) 5/3

45. The distance between the foci of the hyperbola $x^2/9 - y^2/16 = 1$ is
(1) 5
(2) 8
(3) 10
(4) 25/3

46. The yz-plane divides the line segment joining A(2, 4, 5) and B(3, 5, −4) in the ratio
(1) 2 : 3 internally
(2) 3 : 2 internally
(3) 3 : 2 externally
(4) 2 : 3 externally

47. Evaluate:
$$\lim_{x\to0} \frac{tanx - \sin x}{x^3}$$
(1) 1
(2) 1/3
(3) 0
(4) 1/2

48. If $y = x^x$ $(x > 0)$, then the value of dy/dx at x = 1 is
(1) 0
(2) 1
(3) e
(4) 2

49. The mean and variance of 5 observations are 4 and 5.2 respectively. If three of the observations are 1, 2 and 6, the other two observations are
(1) 2 and 9
(2) 3 and 8
(3) 5 and 6
(4) 4 and 7

50. Two fair dice are thrown. The probability that the sum of the numbers is divisible by 3 or 4 is
(1) 1/2
(2) 4/9
(3) 5/9
(4) 7/18

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