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 is a fundamental physical quantity?
(1) Speed
(2) Force
(3) Mass
(4) Density

2. A body moves 12 m towards the east, then 5 m towards the west. The ratio of distance travelled to the magnitude of displacement is:
(1) 17 : 7
(2) 7 : 17
(3) 12 : 5
(4) 5 : 12

3. The momentum of a body changes from 10 kg·m/s to 30 kg·m/s in 4 s. The net force acting on it is:
(1) 2 N
(2) 5 N
(3) 10 N
(4) 20 N

4. Two bodies of mass 10 kg and 20 kg are 1 m apart. The gravitational force between them is:
(1) 6.67×10^{-11} N
(2) 1.33×10^{-8} N
(3) 1.33×10^{-9} N
(4) 6.67×10^{-9} N

5. An object is placed 30 cm in front of a concave mirror of focal length 15 cm. The image formed is:
(1) At 30 cm in front of the mirror, real, inverted, same size
(2) At 60 cm in front of the mirror, real, inverted, magnified
(3) At 10 cm in front of the mirror, real, inverted, diminished
(4) At 30 cm behind the mirror, virtual, erect, same size

6. Three resistors of 2 Ω, 3 Ω and 6 Ω are connected in parallel. The equivalent resistance is:
(1) 1 Ω
(2) 11 Ω
(3) 2 Ω
(4) 0.5 Ω

7. A concave mirror forms a real image twice the size of the object when the object is 15 cm from the mirror. The focal length of the mirror is:
(1) −10 cm
(2) −20 cm
(3) −30 cm
(4) −45 cm

8. A 12 V battery is connected to a 4 Ω resistor in series with a parallel combination of 6 Ω and 3 Ω resistors. The current through the 3 Ω resistor is:

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(1) 2 A
(2) 1.33 A
(3) 0.67 A
(4) 4 A

9. Which statement about the magnetic field inside a long current-carrying solenoid is correct?
(1) It is zero
(2) It is non-uniform and strongest near the ends
(3) It is uniform and parallel to the axis of the solenoid
(4) It is circular around each turn throughout the interior

10. A car travels the first half of a journey at 30 km/h and the second half at 60 km/h. Its average speed is:
(1) 40 km/h
(2) 45 km/h
(3) 50 km/h
(4) 35 km/h

11. The same force acts separately on bodies of mass 2 kg and 4 kg. The ratio of their accelerations ($a_1 : a_2$) is:
(1) 1 : 2
(2) 2 : 1
(3) 1 : 1
(4) 4 : 1

12. A person has a mass of 60 kg on Earth. On the Moon, where g is one-sixth of Earth's value, his mass and weight are:
(1) 10 kg and 98 N
(2) 60 kg and 98 N
(3) 60 kg and 588 N
(4) 10 kg and 588 N

13. A convex mirror has a radius of curvature of 40 cm. An object is placed 30 cm in front of it. The image distance is:
(1) +12 cm
(2) −12 cm
(3) +60 cm
(4) +20 cm

14. A current of 2 A flows through a 10 Ω resistor for 5 minutes. The heat produced is:
(1) 200 J
(2) 6000 J
(3) 12000 J
(4) 60000 J

15. A 2 kg ball is dropped from a height of 20 m. The speed with which it hits the ground is:
(1) 10 m/s
(2) 20 m/s
(3) 40 m/s
(4) 200 m/s

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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. A clean zinc rod is dipped in copper sulphate solution for some time, then removed, washed, dried and weighed. Compared with its original mass (Zn = 65, Cu = 63.5), the rod's mass will:
(1) Increase, because copper is heavier than zinc
(2) Decrease slightly
(3) Remain exactly the same
(4) Increase, because a layer of zinc sulphate forms on it

17. When butane (C_4H_{10}) burns completely, the balanced equation is written with the smallest whole-number coefficients. What is the sum of all coefficients (reactants + products)?
(1) 25
(2) 29
(3) 33
(4) 37

18. 100 mL of an HCl solution of pH 2 is mixed with 100 mL of another HCl solution of pH 4. The pH of the mixture is closest to:
(1) 3.0
(2) 2.3
(3) 3.3
(4) 4.0

19. 8.4 g of baking soda ($NaHCO_3$, molar mass 84 g/mol) is heated strongly until no further change occurs. The volume of CO_2 released at STP is:
(1) 2.24 L
(2) 0.56 L
(3) 4.48 L
(4) 1.12 L

20. A metal M does not liberate hydrogen from dilute HCl, but it displaces silver from silver nitrate solution. M is most likely:
(1) Zinc
(2) Iron
(3) Gold
(4) Copper

21. Which of the following metal oxides can be reduced to the metal by heating with carbon (coke) in a furnace?
(1) Na_2O
(2) MgO
(3) ZnO
(4) Al_2O_3

22. Four identical iron nails are kept in different conditions. In which will rusting be fastest?
(1) Dry air containing anhydrous $CaCl_2$
(2) Boiled distilled water with a layer of oil on top
(3) Salt water open to air
(4) Distilled water in a sealed, air-free tube

23. The IUPAC name of $CH_2=CH–CH_2–CH(CH_3)–CH_3$ is:
(1) 2-Methylpent-4-ene
(2) 4-Methylpent-1-ene
(3) 2-Methylpent-1-ene
(4) 4-Methylpent-2-ene

24. Compound A (C_2H_6O) reacts with sodium to release

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hydrogen. On warming with acidified $K_2Cr_2O_7$ (orange turns green) it forms B. B gives brisk effervescence with $NaHCO_3$. A and B are respectively:
(1) Ethanol and ethanoic acid
(2) Dimethyl ether and methanoic acid
(3) Ethanol and ethanal
(4) Ethanoic acid and ethanol

25. Which statement correctly explains why soap forms scum in hard water but a detergent does not?
(1) Soap forms insoluble calcium/magnesium salts of its carboxylate, while detergent salts remain soluble
(2) Soap is non-ionic while detergent is ionic
(3) Soap has no hydrophobic tail
(4) Detergents react with Ca^{2+} to form scum, but soaps do not

26. Element X has electronic configuration 2, 8, 7 and element Y has 2, 8, 2. The compound formed between them is best described as:
(1) YX, ionic
(2) YX_2, ionic
(3) YX_2, covalent
(4) Y_2X, ionic

27. The species O^{2-}, F^-, Na^+ and Mg^{2+} are isoelectronic. Their radii increase in the order:
(1) $O^{2-} < F^- < Na^+ < Mg^{2+}$
(2) $Mg^{2+} < Na^+ < F^- < O^{2-}$
(3) $Na^+ < Mg^{2+} < O^{2-} < F^-$
(4) $F^- < O^{2-} < Mg^{2+} < Na^+$

28. A compound has 40% C, 6.7% H and 53.3% O by mass. If its molar mass is 180 g/mol, its molecular formula is (C = 12, H = 1, O = 16):
(1) CH_2O
(2) $C_3H_6O_3$
(3) $C_5H_{10}O_5$
(4) $C_6H_{12}O_6$

29. Aqueous $CuSO_4$ is electrolysed first with inert platinum electrodes and then with copper electrodes. Which observation is true only for the copper electrodes?
(1) Copper deposits at the cathode
(2) The blue colour of the solution remains unchanged, and the anode loses mass
(3) Oxygen gas is evolved at the anode
(4) The solution becomes acidic

30. An ion X^{3+} has 10 electrons and a mass number of 27. The number of neutrons in one atom of X is:
(1) 13
(2) 10
(3) 17
(4) 14

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SECTION : MATHEMMATICS

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. The number of positive integers x satisfying both $3x - 7 < 11$ and $2x + 1 \geq 5$ is
(1) 3
(2) 5
(3) 6
(4) 4

32. If one root of $x^2 - 6x + k = 0$ is twice the other root, then k is equal to
(1) 9
(2) 8
(3) 12
(4) 6

33. If α and β are the roots of $x^2 - 4x + 1 = 0$, then $\alpha^3 + \beta^3$ is equal to
(1) 48
(2) 56
(3) 60
(4) 52

34. If a : b = 2 : 3 and b : c = 4 : 5, then a : c is
(1) 8 : 15
(2) 2 : 5
(3) 6 : 5
(4) 10 : 12

35. If $(x - 2)$ is a factor of $x^3 - 3x^2 + kx - 6$, then the value of k is
(1) 3
(2) 5
(3) 4
(4) 6

36. If $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$, then the determinant $|2A|$ is equal to
(1) −8
(2) −4
(3) 8
(4) −16

37. If $A = \begin{bmatrix} 3 & 1 \\ 5 & 2 \end{bmatrix}$, then the sum of all the elements of A^{-1} is
(1) −1
(2) 0
(3) 1
(4) 5

38. The sum of all two-digit natural numbers which are multiples of 7 is
(1) 665
(2) 735
(3) 784
(4) 728

39. The first term of an infinite GP is 6 and its sum is 9. The common ratio is
(1) 2/3
(2) 1/4
(3) 1/3
(4) 3/2

40. The area of the triangle with vertices (1, 2), (4, 6) and (7, 2) in square units is
(1) 24
(2) 6
(3) 14
(4) 12

41. The point which divides the line segment joining (1, 2) and (7, 8) internally in the ratio 1 : 2 is
(1) (3, 4)
(2) (4, 5)
(3) (5, 6)
(4) (2, 3)

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42. In ΔABC, D lies on AB and E lies on AC such that DE $\parallel$ BC. If AD = 4 cm, DB = 6 cm and AE = 3 cm, then EC is
(1) 2 cm
(2) 4 cm
(3) 4.5 cm
(4) 6 cm

43. In a circle with centre O, a chord AB subtends $\angle AOB = 110°$ at the centre. If C is a point on the major arc AB, then $\angle ACB$ is
(1) 110°
(2) 55°
(3) 70°
(4) 125°

44. ABCD is a cyclic quadrilateral in which $\angle A = 85°$ and $\angle B = 70°$. Then $\angle C$ is
(1) 85°
(2) 70°
(3) 95°
(4) 110°

45. From an external point P, a tangent PT and a secant PAB are drawn to a circle, with A between P and B. If PA = 4 cm and AB = 5 cm, then PT is
(1) 4.5 cm
(2) 6 cm
(3) 9 cm
(4) 36 cm

46. A solid metallic sphere of radius 6 cm is melted and recast into small spheres of radius 2 cm each. The number of small spheres obtained is
(1) 9
(2) 27
(3) 18
(4) 36

47. The curved surface area of a cone of base radius 5 cm and height 12 cm is
(1) 65π cm^2
(2) 60π cm^2
(3) 130π cm^2
(4) 90π cm^2

48. From a point 50 m away from the foot of a tower on level ground, the angle of elevation of the top of the tower is 60°. The height of the tower is
(1) 50 m
(2) $100/\sqrt{3}$ m
(3) $50\sqrt{3}$ m
(4) $25\sqrt{3}$ m

49. For a moderately skewed distribution, the mean is 18 and the median is 20. Using the empirical relation, the mode is
(1) 22
(2) 26
(3) 19
(4) 24

50. A bag contains 5 red and 3 blue balls. Two balls are drawn one after the other without replacement. The probability that both are red is
(1) 25/64
(2) 5/14
(3) 5/16
(4) 3/7

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