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. Rain falls vertically at 12 km/h. A man walks at 5 km/h on a horizontal road. The speed of the rain relative to the man is:
(1) 7 km/h
(2) 17 km/h
(3) 13 km/h
(4) 12 km/h

2. The coefficient of friction between a car's tyres and a flat road is 0.9. The maximum speed with which the car can safely turn on a circular path of radius 100 m is:
(1) 20 m/s
(2) 15 m/s
(3) 45 m/s
(4) 30 m/s

3. A force F = 6t N acts on a 3 kg body initially at rest. The work done in the first 2 s is:
(1) 12 J
(2) 24 J
(3) 36 J
(4) 48 J

4. A uniform rod of mass M and length L, pivoted at one end, is released from the horizontal position. Its angular acceleration just after release is:
(1) g/L
(2) 3g/2L
(3) 2g/3L
(4) 3g/L

5. The work needed to raise a 100 kg mass from the Earth's surface to a height equal to Earth's radius R = 6400 km is:
(1) 3.2×10^9 J
(2) 6.4×10^9 J
(3) 1.6×10^9 J
(4) 6.4×10^8 J

6. A Carnot engine works between 500 K and 300 K. If it absorbs 1000 J from the source, the work done per cycle is:
(1) 300 J
(2) 600 J
(3) 400 J
(4) 500 J

7. The length of a simple pendulum is increased by 2%. The time period:
(1) increases by about 1%
(2) increases by about 2%
(3) increases by about 4%
(4) decreases by about 1%

8. Charges +4 μC and +1 μC are 3 m apart. The point on the line joining them where the net field is zero is at a distance from the 4 μC charge of:
(1) 1 m
(2) 1.5 m
(3) 2 m

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(4) 2.4 m

9. A wire of resistance 4 Ω is bent into a circle. The resistance between two diametrically opposite points is:
(1) 2 Ω
(2) 1 Ω
(3) 4 Ω
(4) 0.5 Ω

10. A 2 μF capacitor charged to 100 V is disconnected and connected across an uncharged 3 μF capacitor. The common potential is:
(1) 60 V
(2) 40 V
(3) 50 V
(4) 100 V

11. A 6 Ω and a 3 Ω resistor in parallel are connected in series with a 4 Ω resistor. The equivalent resistance is:
(1) 13 Ω
(2) 9 Ω
(3) 4.5 Ω
(4) 6 Ω

12. Two long parallel wires 0.1 m apart carry 10 A and 5 A in the same direction. The force per unit length between them is:
(1) 10^{-4} N/m
(2) 10^{-5} N/m
(3) 2×10^{-4} N/m
(4) 10^{-3} N/m

13. The current through a 2 H inductor changes from 5 A to 1 A in 0.2 s. The magnitude of the induced emf is:
(1) 10 V
(2) 40 V
(3) 20 V
(4) 80 V

14. A coin lies at the bottom of a 12 cm deep water tank (μ = 4/3). Viewed from directly above, it appears at a depth of:
(1) 9 cm
(2) 16 cm
(3) 12 cm
(4) 8 cm

15. A radioactive sample has a half-life of 10 days. The time taken for 87.5% of it to decay is:
(1) 20 days
(2) 40 days
(3) 30 days
(4) 70 days

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. Which of the following concentration terms changes with a change in temperature?
(1) Molality
(2) Mole fraction
(3) Molarity
(4) Mass percentage

17. An electron and a proton are accelerated so that both have the same kinetic energy. Which statement about their de Broglie wavelengths is correct?
(1) The proton has the longer wavelength
(2) The electron has the longer

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wavelength
(3) Both have equal wavelengths
(4) It cannot be determined without knowing the velocities

18. Assertion (A): Chlorine has a more negative electron gain enthalpy than fluorine.
Reason (R): The small size of fluorine causes strong inter-electronic repulsion in its compact 2p subshell, which reduces the energy released when it gains an electron.
(1) Both A and R are true, and R explains A
(2) Both are true, but R does not explain A
(3) A is true, R is false
(4) A is false, R is true

19. Arrange O_2^+, O_2, O_2^- and O_2^{2-} in increasing order of bond length.
(1) $O_2^+ < O_2 < O_2^- < O_2^{2-}$
(2) $O_2^{2-} < O_2^- < O_2 < O_2^+$
(3) $O_2 < O_2^+ < O_2^- < O_2^{2-}$
(4) $O_2^+ < O_2^- < O_2 < O_2^{2-}$

20. A process is spontaneous at low temperature but becomes non-spontaneous at high temperature. The signs of ΔH and ΔS for this process are:
(1) ΔH negative, ΔS positive
(2) ΔH negative, ΔS negative
(3) ΔH positive, ΔS positive
(4) ΔH positive, ΔS negative

21. The solubility product of AgCl is 1.8×10^{-10} at 298 K. Its solubility in 0.1 M NaCl solution is approximately:
(1) 1.3×10^{-5} M
(2) 1.8×10^{-9} M
(3) 1.8×10^{-10} M
(4) 1.8×10^{-5} M

22. Which of the following will give a white precipitate with ammoniacal silver nitrate solution?
(1) But-2-yne
(2) But-1-yne
(3) But-1-ene
(4) Butane

23. Assertion (A): Frenkel defect does not change the density of a crystal.
Reason (R): In Frenkel defect, an ion moves from its lattice site to an interstitial site, so no ions leave the crystal.
(1) Both A and R are true, and R explains A
(2) Both are true, but R does not explain A
(3) A is true, R is false
(4) A is false, R is true

24. Which aqueous solution has the highest boiling point? (Assume complete dissociation of electrolytes.)
(1) 0.1 m glucose
(2) 0.1 m NaCl
(3) 0.1 m $CaCl_2$
(4) 0.1 m $AlCl_3$

25. In the Daniell cell Zn | Zn^{2+} (aq) || Cu^{2+} (aq) | Cu, the concentration of Zn^{2+} is increased tenfold while $[Cu^{2+}]$ is kept constant. At 298 K, the EMF of the cell:
(1) increases by 0.059 V
(2) decreases by 0.0295 V
(3) decreases by 0.059 V
(4) increases by 0.0295 V

26. A first-order reaction has a half-life of 20 minutes. The time taken for the reaction to be 87.5% complete is:
(1) 40 min
(2) 60 min
(3) 80 min
(4) 100 min

27. Which option correctly describes the geometry and magnetic behaviour of $[NiCl_4]^{2-}$ and $[Ni(CN)_4]^{2-}$?

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(1) $[NiCl_4]^{2-}$: square planar, diamagnetic; $[Ni(CN)_4]^{2-}$: tetrahedral, paramagnetic
(2) $[NiCl_4]^{2-}$: tetrahedral, paramagnetic; $[Ni(CN)_4]^{2-}$: square planar, diamagnetic
(3) Both are tetrahedral and paramagnetic
(4) Both are square planar and diamagnetic

28. (R)-2-Bromobutane reacts with aqueous NaOH by the SN2 mechanism. The major product is:
(1) (R)-butan-2-ol, with retention of configuration
(2) (S)-butan-2-ol, with inversion of configuration
(3) A racemic mixture of butan-2-ol
(4) Butan-1-ol

29. Which of the following will undergo the Cannizzaro reaction but not the aldol condensation?
(1) Ethanal
(2) Propanone
(3) Benzaldehyde
(4) 2-Methylpropanal

30. The correct order of basic strength in aqueous solution is:
(1) $(CH_3)_3N > (CH_3)_2NH > CH_3NH_2 > NH_3 > C_6H_5NH_2$
(2) $(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N > NH_3 > C_6H_5NH_2$
(3) $CH_3NH_2 > (CH_3)_2NH > (CH_3)_3N > C_6H_5NH_2 > NH_3$
(4) $NH_3 > CH_3NH_2 > (CH_3)_2NH > (CH_3)_3N > C_6H_5NH_2$

SECTION : BIOLOGY

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 nuclei in a mature tapetal cell is often more than one because of:
(1) Meiosis
(2) Amitosis
(3) Cytokinesis without Karyokinesis
(4) Karyokinesis without Cytokinesis

32. Why, at higher light intensities, gradually photosynthesis rate does not show further increase?
(1) Higher light intensity activate more chlorophylls.
(2) Higher light intensity causes more transpiration.
(3) No need of more sugar formation.
(4) Other factors become limiting.

33. . Saheli, the first non-steroidal oral contraceptive pill for females developed in India (CDRI, Lucknow), contains which active component?

(1) Progesterone-estrogen combination

(2) Centchroman

(3) Synthetic testosterone derivatives

(4) Prostaglandins

34. In recombinant DNA technology, if a foreign DNA fragment is ligated into the PstI site of the Ampicillin resistance gene amp^R in plasmid vector pBR322, the recombinant colonies will:

(1) Grow on ampicillin, but die on tetracycline.

(2) Die on ampicillin-containing medium, but grow on tetracycline medium.

(3) Grow on both antibiotics normally.

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(4) Die on both antibiotic media.

35. The geological time scale divides Earth's history into eras and periods. Amphibians and reptiles evolved and flourished predominantly during which major geological era?

(1) Cenozoic Era

(2) Mesozoic Era

(3) Paleozoic Era

(4) Proterozoic Era

36. To make 100 molecules of glucose, how many molecules of ATP & NADPH are required?
(1) 1800 and 1200 respectively.
(2) 1200 and 1800 respectively.
(3) 1800 and 600 respectively.
(4) 200 and 600 respectively

37. . Down's syndrome is caused by an extra copy of chromosome number 21. What precentage of offspring produced by an affected mother and a normal father?
(1) 50%
(2) 25%
(3) 100%
(4) 75%

38. Expressed Sequence Tags (ESTs) refers to
(1) All genes that are expressed as RNA.
(2) All genes that are expressed as proteins.
(3) All genes whether expressed or udexpressed.
(4) Certain important expressed genes

39. Juxtaglomerular Apparatus (JGA) is a specialized cellular region formed by cellular modifications in the:

(1) Distal convoluted tubule and the afferent arteriole

(2) Proximal convoluted tubule and the efferent arteriole

(3) Loop of Henle and peritubular capillaries

(4) Bowman's capsule and podocytes

40. Which of the following joints is categorized as a cartilaginous joint where little or no movement is permitted?

(1) Humerus and pectoral girdle (shoulder joint)

(2) Between cranial bones (sutures)

(3) Between adjacent vertebrae in the vertebral column

(4) Knee joint

41. 4. Carbon monoxide (CO) poisoning is lethal primarily because:

(1) CO competitively binds to hemoglobin with an affinity nearly 200–250 times higher than oxygen, forming stable carboxyhemoglobin.

(2) CO binds irreversibly to the respiratory rhythm center in the medulla oblongata, paralyzing diaphragm movement.

(3) CO destroys the alveolar membrane, causing pulmonary edema.

(4) CO reacts with blood plasma to form strong acids, causing fatal acidosis.

42. 1. Match List-I with List-II.

	List-I		**List-II**
(1)	Metacentric chromosome	(i)	Centromere situated close to the end forming one extremely short and one very long arms
(2)	Acrocentric chromosome	(ii)	Centromere at the terminal end

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(3)	Submetacentric	(iii)	Centromere in the middle forming two equal arms of chromosomes
(4)	Telocentric chromosome	(iv)	Centromere slightly away from the middle forming one shorter arm and one longer arm

Choose the correct answer from the options given below :
(1) (1)-(i), (2)-(ii), (3)-(iii), (4)-(iv)
(2) (1)-(iii), (2)-(i), (3)-(iv), (4)-(ii)
(3) (1)-(i), (2)-(iii), (3)-(ii), (4)-(iv)
(4) (1)-(ii), (2)-(iii), (3)-(iv), (4)-(i)

43. The flowers are Zygomorphic in:
(1) Mustard
(2) Gulmohar
(3) Cassia
(4) Datura
(e) Chilly
Choose the correct answer from the options given below:
(1) (3), (4), (e) Only
(2) (1), (2), (3) Only
(3) (2), (3) Only
(4) (4), (e) Only

44. Which of the following occurs due to the presence of autosome linked dominant trait ? (1) Thalessemia
(2) Sickle cell anaemia
(3) Myotonic dystrophy
(4) Haemophilia

45. . Hydrocolloid carrageen is obtained from:
(1) Phaeophyceae only
(2) Chlorophyceae and Phaeophyceae
(3) Phaeophyceae and Rhodophyceae
(4) Rhodophyceae only

46. Identify the incorrect statement.
(1) Recombinase is required at pachytene stage.
(2) The complex formed by a pair of synapsed homologous chromosomes is called tetrad.
(3) Diakinesis can last for months or years in the oocytes of some vertebrates. (4) Dissolution of the synaptonemal complex occurs during diplotene

47. . During oogenesis, primary oocytes are arrested in which cell division phase during embryonic development before resuming years later at puberty?

(1) Prophase I of Meiosis I

(2) Metaphase II of Meiosis II

(3) Anaphase I of Meiosis I

(4) Interphase before Meiosis II

48. Calcium homeostasis in the human blood is delicately balanced by the antagonistic actions of two hormones:

(1) Insulin and Glucagon

(2) Thyroxine and Calcitonin

(3) Calcitonin and Parathyroid Hormone

(4) Cortisol and Aldosterone

49. 1.The total volume of air a person can expire after a maximum inspiration is known as:

(1) Residual Volume

(2) Functional Residual Capacity

(3) Vital Capacity

(4) Total Lung Capacity

50. During joint diastole:

(1) Semilunar valves are open, and AV valves are closed.

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(2) Both AV valves and semilunar valves are closed.

(3) AV valves are open, allowing blood to flow passively from atria into ventricles.

(4) Blood is actively pumped out of the ventricles into the aorta and pulmonary artery.

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