SAMPLE PAPER
GRADE – 11th PCM

SECTION – A (English)

1. **Select the sentence where the definite article is correctly employed before an abstract noun qualified by a restrictive clause :**
   (A) The science has transformed modern ballistics significantly.
   (B) The accuracy which was observed in the particle trajectory verified the hypothesis.
   (C) An accuracy of quantum measurement is difficult to maintain.
   (D) The physics of semiconductors requires a deep conceptual foundation.
2. **Fill in the blank with the appropriate determiner :**
   'The astrophysicist noted that _____ empirical data collected during the solar eclipse was sufficient to corroborate the gravitational deflection theorem.'
   (A) few (B) the few
   (C) the little (D) little
3. **Identify the sentence demonstrating the correct use of the mandative subjunctive mood in a scientific protocol :**
   (A) The safety manual requires that the technician calibrates the mass spectrometer before each run.
   (B) The safety manual requires that the technician calibrate the mass spectrometer before each run.
   (C) The safety manual requires that the technician calibrated the mass spectrometer before each run.
   (D) The safety manual requires that the technician is calibrating the mass spectrometer before each run.
4. **Choose the modal construction expressing a logical past deduction regarding an unexpected laboratory anomaly :**
   (A) The cryogenic chamber must have experienced a seal rupture when thermal expansion occurred.
   (B) The cryogenic chamber should have experienced a seal rupture when thermal expansion occurred.
   (C) The cryogenic chamber would have experienced a seal rupture when thermal expansion occurred.
   (D) The cryogenic chamber could experience a seal rupture when thermal expansion occurred.
5. **Convert the following scientific hypothesis into indirect speech :**
   The lead researcher said, 'If the pressure drops below critical threshold, the liquid crystal will immediately crystallize.'
   (A) The lead researcher stated that if the pressure drops below critical threshold, the liquid crystal would immediately crystallize.
   (B) The lead researcher stated that if the pressure dropped below critical threshold, the liquid crystal would immediately crystallize.
   (C) The lead researcher explained that if the pressure had dropped below critical threshold, the liquid crystal would have crystallized.
   (D) The lead researcher said if the pressure dropped below threshold the crystal crystallizes.

6. Supply the correct question tag :

'Scarcely any variance was detected across three successive titration trials, _____ ?'

(A) was it (B) wasn't it

(C) did it (D) didn't it

7. Fill in the blank with the appropriate dependent preposition :

'The structural integrity of the titanium alloy is immune _____ galvanic corrosion in saline conditions.'

(A) from (B) against

(C) to (D) with

8. Choose the phrasal verb meaning 'to yield or give way under continuous mechanical stress' :

'The carbon – fiber truss began to _____ under an unexpected torsional load during supersonic wind – tunnel testing.'

(A) give in (B) give out

(C) give over (D) give up

9. What does the technical idiom 'to reinvent the wheel' denote in scientific design ?

(A) To optimize a patented propulsion system

(B) To waste time and resources creating something that already exists and works effectively

(C) To formulate a radically revolutionary physical paradigm

(D) To rectify a chronic flaw in an experimental apparatus

10. Select the sentence containing an error in Subject – Verb Agreement :

(A) Neither the radio telescope nor the optical observatories were able to register the gamma – ray burst.

(B) The number of anomalous readings recorded by the sensors has increased exponentially.

(C) Ten milliliters of pure sulfuric acid are added to the solution drop by drop.

(D) The criterion for determining thermodynamic equilibrium was rigorously applied.

11. Select the sentence where the definite article is correctly used to denote a whole class through a singular countable noun without violating scientific generality :

(A) Man is the only organism capable of manipulating quantum states artificially.

(B) The man is the only organism capable of manipulating quantum states artificially.

(C) A man is the only organism capable of manipulating quantum states artificially.

(D) Men are the only organism capable of manipulating quantum states artificially.

12. Choose the sentence where the indefinite article is used correctly based on phonetic pronunciation :

(A) The lab acquired an uniaxial crystal for optical polarization tests.

(B) The nuclear reactor requires a enriched uranium core to sustain fission.

(C) The technician filed an FIR after discovering the radiation leak.

(D) He is an university – trained astrophysicist specializing in pulsars.

13. Fill in the blank with the most precise determiner :

'Although the particle accelerator ran for six weeks, _____ antimatter was synthesized — barely enough to register on the magnetic trap sensors.'

(A) little (B) a little

(C) the little (D) few

14. Complete the sentence with the correct determiner :

'The safety inspector tested the two backup generators, but _____ of them functioned when the primary grid failed.'

(A) none (B) neither

(C) either (D) any

15. Identify the sentence that correctly employs a non – finite participle without creating a dangling modifier :

(A) Analyzing the emission spectrum through the prism, the presence of helium was confirmed.

(B) Having cooled to absolute zero, the physicist observed the liquid helium turn superfluid.

(C) While titrating the acidic solution, the burette valve suddenly jammed.

(D) Peering through the electron microscope, the geneticist observed the viral capsid fracturing.

SECTION – B (Physics)

16. The physical quantity that does NOT share the same dimensional formula as the other three is :

(A) Work (B) Torque

(C) Angular momentum (D) Energy

17. A particle moves along a straight line such that its displacement x at time t is given by x = 4t² - 16t + 12 (where x is in meters and t in seconds). The velocity of the particle when its acceleration becomes zero or at time t = 0 is −16 m/s. At what time does the particle momentarily come to rest ?

(A) t = 1 s (B) t = 2 s (C) t = 3 s (D) t = 4 s

18. Two projectiles are launched with identical initial speed u from the same point at angles θ and (90° − θ) with the horizontal respectively. If R_1 and R_2 represent their horizontal ranges, and H_1 and H_2 their maximum heights, which of the following relations is correct ?

(A) $R_1 \neq R_2$ and $H_1 = H_2$ (B) $R_1 = R_2$ and $R_1 = 4\sqrt{H_1 . H_2}$

(C) $R_1 = R_2$ and $R_1 = 2(H_1 + H_2)$ (D) $R_1 \neq R_2$ and $R_1 = 16\, H_1\, H_2$

19. A block of mass 5 kg rests on a rough horizontal surface having coefficient of static friction μ_s = 0.4 and coefficient of kinetic friction μ_k = 0.3. If a horizontal pulling force of 15 N is applied to the block (taking g = 10 m/s²), the frictional force acting on the block is :

(A) 20 N (B) 15 N (C) 12 N (D) 0 N

20. A position – dependent force F(x) = (3x² – 2x + 5) N acts on a body of mass 2 kg, displacing it from x = 0 m to x = 2 m. The total work done by the force on the body is :

(A) 10 J (B) 14 J (C) 18 J (D) 22 J

21. A thin uniform circular ring and a uniform solid disc having identical mass M and outer radius R roll down an inclined plane without slipping starting from rest at the same height. The ratio of the linear speed of the center of mass of the disc to that of the ring at the bottom of the incline is :

(A) $\sqrt{\left(\frac{3}{4}\right)}$ (B) $\sqrt{\left(\frac{4}{3}\right)}$ (C) $\frac{2}{1}$ (D) $\sqrt{\left(\frac{2}{3}\right)}$

22. If the radius of the Earth were to shrink by 1% while its total mass remained strictly unchanged, the acceleration due to gravity (g) on the surface of the Earth would :

(A) Decrease by 1% (B) Increase by 1% (C) Decrease by 2% (D) Increase by 2%

23. Two wires A and B are made of the same material. The length of wire A is L and its diameter is d; the length of wire B is 2L and its diameter is 2d. If both wires are subjected to equal stretching forces F, the ratio of the elongation produced in wire A to that in wire B ($\Delta L_A : \Delta L_B$) is :

(A) 1 : 1 (B) 1 : 2 (C) 2 : 1 (D) 4 : 1

24. Twenty – seven identical spherical water droplets, each charged to a potential V and having radius r, coalesce to form a single larger spherical drop. If the surface tension of water is T, the excess pressure inside the combined spherical drop of radius R compared to that inside an individual smaller droplet is :

(A) 3 times smaller (B) 3 times greater (C) 9 times smaller (D) Unchanged

25. A spherical black body of radius r radiates power E at an absolute temperature T. If its radius is halved and its absolute temperature is doubled, the power radiated by the body will become :

(A) E (B) 2 E (C) 4 E (D) 16 E

26. During an adiabatic expansion of an ideal gas, the volume increases by 3 times. If the ratio of specific heats is γ = 1.5, the temperature of the gas changes such that the ratio of final temperature to initial temperature $\left(\frac{T_f}{T_i}\right)$ is :

(A) $\frac{1}{\sqrt{3}}$ (B) $\frac{1}{3}$ (C) 3 (D) $\sqrt{3}$

27. An ideal gas mixture consists of 2 moles of Helium (He, monoatomic, C_v = 1.5 R) and 1 mole of Oxygen (O_2, diatomic, C_v = 2.5 R). The equivalent molar heat capacity of the mixture at constant volume (C_v,mix) is :

(A) 1.67 R (B) 1.83 R (C) 2.00 R (D) 2.17 R

28. The displacement of a particle executing simple harmonic motion is given by y = 0.05 sin(100π t + π/4) in SI units. The maximum velocity and maximum acceleration of the particle are respectively :

(A) 5π m/s and 500π² m/s²

(B) 0.05 m/s and 100π m/s²

(C) 5π m/s and 250π² m/s²

(D) 10π m/s and 1000π² m/s²

29. A pipe open at both ends produces a fundamental frequency of 300 Hz. If one end of this open pipe is now closed, the frequency of its third harmonic will be :

(A) 150 Hz (B) 450 Hz (C) 600 Hz (D) 900 Hz

30. Two tuning forks A and B produce 5 beats per second when sounded together. When fork A is loaded with a small piece of wax, the beat frequency decreases to 2 beats per second. If the original frequency of fork B is 384 Hz, the original frequency of tuning fork A was :

(A) 379 Hz (B) 384 Hz (C) 389 Hz (D) 394 Hz

SECTION – C (Chemistry)

31. 1.5 g of an organic compound (molar mass = 60 g mol^{-1}) on combustion produced 2.2 g of CO_2 and 0.9 g of H_2O. The molecular formula of the compound is :

(A) CH_2O (B) C_2H_4O (C) C_2H_6O (D) C_3H_6O

32. The de Broglie wavelength of an electron accelerated from rest through a potential difference of V volts is λ. The wavelength associated with a proton accelerated through the same potential difference is approximately ($m_p = 1836\ m_e$) :

(A) λ/43 (B) λ/1836 (C) 1836 λ (D) 43λ

33. Which of the following has the highest first ionisation enthalpy ?

(A) N (B) O (C) F (D) Ne

34. The correct order of bond angle is :

(A) $NH_3 > H_2O > H_2S > H_2Se$

(B) $NH_3 > H_2S > H_2O > H_2Se$

(C) $H_2O > NH_3 > H_2S > H_2Se$

(D) $NH_3 > H_2O > H_2Se > H_2S$

35. For the reaction $2A(g) + B(g) \rightleftharpoons 2C(g)$; ΔH = –ve and ΔS = –ve. The reaction is :

(A) Spontaneous at all temperatures

(B) Spontaneous only at low temperature

(C) Spontaneous only at high temperature

(D) Non – spontaneous at all temperatures

36. For the equilibrium $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$; ΔH = –92 kJ. The correct statement is :

(A) K_p increases with increase in temperature

(B) K_p decreases with increase in pressure

(C) K_p is unaffected by addition of catalyst

(D) K_p increases with increase in concentration of N_2

37. In the reaction $2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$, the equivalent weight of $KMnO_4$ (molar mass M) is :

(A) $\frac{M}{5}$ (B) $\frac{M}{3}$ (C) $\frac{M}{2}$ (D) M

38. The IUPAC name of the compound $CH_3–CH(CH_3)–CH_2–CC–CH_3$ is :

(A) 4 – Methylhex – 2 – yne

(B) 5 – Methylhex – 2 – yne

(C) 2 – Methylhex – 4 – yne

(D) 5 – Methylhex – 3 – yne

39. The common name of $(CH_3)_3C–OH$ is :

(A) n – Butyl alcohol

(B) sec – Butyl alcohol

(C) Isobutyl alcohol

(D) tert – Butyl alcohol

40. The correct order of acidic strength is :

(A) Phenol > p – nitrophenol > o – nitrophenol

(B) p – Nitrophenol > o – nitrophenol > phenol

(C) o – Nitrophenol > p – nitrophenol > phenol

(D) Phenol > o – nitrophenol > p – nitrophenol

41. Which of the following is aromatic ?

(A) Cyclooctatetraene

(B) Cyclobutadiene

(C) Tropylium cation ($C_7H_7^+$)

(D) Cyclopentadienyl cation

42. The most stable carbocation is :

(A) $(CH_3)_3C^+$ (B) $(CH_3)_2CH^+$ (C) CH_3CH_2+ (D) $CH_2=CH-CH_2^+$

43. The most stable resonating structure of C_{H2}=CH–CH=CH–ÖH is the one in which ?

(A) All atoms have complete octet and negative charge is on oxygen

(B) Carbon has positive charge and oxygen has complete octet

(C) Oxygen has positive charge

(D) All atoms have incomplete octet

44. For the process $H_2O(l)$ $H_2O(g)$ at 100 °C and 1 atm, the correct statement is :

(A) $\Delta H = 0, \Delta S = 0, \Delta G = 0$

(B) $\Delta H > 0, \Delta S > 0, \Delta G = 0$

(C) $\Delta H > 0, \Delta S > 0, \Delta G > 0$

(D) $\Delta H < 0, \Delta S < 0, \Delta G = 0$

45. The oxidation number of Cr in $K_2Cr_2O_7$ and CrO_5 (chromic peroxide) are respectively :

(A) +6, +6 (B) +6, +10 (C) +3, +6 (D) +6, +4

SECTION – D (Mathematics)

46. The value of $81^{(1/\log_5 3)} + 27^{\log_9 36} + 3^{4/\log_7 9}$ is equal to :

(A) 49 (B) 625 (C) 216 (D) 890

47. Given two finite sets *A* and *B* such that *n*(A) = 2, *n*(B) = 3. Then total number of relations from *A* to *B* is :

(A) 4 (B) 8 (C) 64 (D) None of these

48. Solution set of $x \equiv 3$ (mod 7), $p \in Z$, is given by :

(A) $\{3\}$ (B) $\{7p-3 : p \in Z\}$ (C) $\{7p+3 : p \in Z\}$ (D) None of these

49. If $f(x) = \dfrac{\cos^2 x + \sin^4 x}{\sin^2 x + \cos^4 x}$ for $x \in R$, then $f(2002) =$?

(A) 1 (B) 2 (C) 3 (D) 4

50. If $f : R \to R$ satisfies $f(x+y) = f(x) + f(y)$, for all $x, y \in R$ and $f(1) = 7$, then $\sum_{r=1}^{n} f(r)$ is :

(A) $\dfrac{7n}{2}$ (B) $\dfrac{7(n+1)}{2}$ (C) $7n(n+1)$ (D) $\dfrac{7n(n+1)}{2}$

51. For a real number x, $[x]$ denotes the integral part of *x*. The value of $\left[\frac{1}{2}\right] + \left[\frac{1}{2} + \frac{1}{100}\right] + \left[\frac{1}{2} + \frac{2}{100}\right] + \ldots + \left[\frac{1}{2} + \frac{99}{100}\right]$ is :

(A) 49 (B) 50 (C) 48 (D) 51

52. $\tan\alpha + 2\tan 2\alpha + 4\tan 4\alpha + 8\cot 8\alpha =$ **?**

(A) $\tan\alpha$ (B) $\tan 2\alpha$ (C) $\cot\alpha$ (D) $\cot 2\alpha$

53. $\sqrt{3}\,\text{cosec}\,20^o - \sec 20^o =$ **?**

(A) 2 (B) $\dfrac{2\sin 20^o}{\sin 40^o}$ (C) 4 (D) $\dfrac{4\sin 20^o}{\sin 40^o}$

54. If $\cos^6\alpha + \sin^6\alpha + K\sin^2 2\alpha = 1,$ **then *K* = ?**

(A) $\dfrac{4}{3}$ (B) $\dfrac{3}{4}$ (C) $\dfrac{1}{2}$ (D) 2

55. The value of $\sin\dfrac{\pi}{14}\sin\dfrac{3\pi}{14}\sin\dfrac{5\pi}{14}\sin\dfrac{7\pi}{14}\sin\dfrac{9\pi}{14}\sin\dfrac{11\pi}{14}\sin\dfrac{13\pi}{14}$ **is equal to :**

(A) $\dfrac{1}{8}$ (B) $\dfrac{1}{16}$ (C) $\dfrac{1}{32}$ (D) $\dfrac{1}{64}$

56. If $x = -5 + 2\sqrt{-4},$ **then the value of the expression** $x^4 + 9x^3 + 35x^2 - x + 4$ **is :**

(A) 160 (B) –160 (C) 60 (D) –60

57. If $(1+i)(1+2i)(1+3i).....(1+ni) = a + ib$ **, then 2.5.10....** $(1+n^2)$ **is equal to :**

(A) $a^2 - b^2$ (B) $a^2 + b^2$ (C) $\sqrt{a^2 + b^2}$ (D) $\sqrt{a^2 - b^2}$

58. The G.M. of the numbers $3, 3^2, 3^3, ..., 3^n$ **is :**

(A) $3^{2/n}$ (B) $3^{(n-1)/2}$ (C) $3^{n/2}$ (D) $3^{(n+1)/2}$

59. The relation between the median *M*, the second quartile Q_2 **, the fifth decile** D_5 **and the 50th percentile** P_{50} **, of a set of observations is :**

(A) $M = Q_2 = D_5 = P_{50}$ (B) $M < Q_2 < D_5 < P_{50}$

(C) $M > Q_2 > D_5 > P_{50}$ (D) None of these

60. If *n* positive integers are taken at random and multiplied together, the probability that the last digit of the product is 2, 4, 6 or 8, is :

(A) $\dfrac{4^n + 2^n}{5^n}$ (B) $\dfrac{4^n \times 2^n}{5^n}$ (C) $\dfrac{4^n - 2^n}{5^n}$ (D) None of these