

Questions  
**100 MCQs**

Marks  
**300 (+3 each)**

Time  
**150 minutes**

Negative marking  
**–1 per wrong answer**

| Part   | Section               | Questions | Q. No.    |
|--------|-----------------------|-----------|-----------|
| Part A | Mathematics           | 40        | 1 to 40   |
| Part B | Physics               | 25        | 41 to 65  |
| Part C | Chemistry             | 20        | 66 to 85  |
| Part D | Quantitative Aptitude | 10        | 86 to 95  |
| Part E | English               | 5         | 96 to 100 |

### Instructions

- This paper has 100 multiple-choice questions: Mathematics (Q1–40), Physics (Q41–65), Chemistry (Q66–85), Quantitative Aptitude (Q86–95) and English (Q96–100).
- Each question has four options, of which only ONE is correct.
- Each correct answer carries 3 marks and each wrong answer carries –1 mark. A question left unanswered gets 0. Maximum marks: 300.
- Time: 150 minutes (2.5 hours). Calculators, log tables and mobile phones are not allowed; in the real computer-based test, using the on-screen system calculator leads to disqualification.
- The answer key and short solutions are at the end. Check them only after you finish.

This is an AglaSem practice paper written on the latest official AEEE pattern (100 questions, 300 marks, 150 minutes, +3/–1) and the AEEE syllabus (Appendix II of the AEEE 2026 brochure). It is not an official Amrita Vishwa Vidyapeetham paper, and its questions are original. The real AEEE is a computer-based test in English.

## Part A

### Mathematics

- If  $n(A) = 40$ ,  $n(B) = 25$  and  $n(A \cap B) = 10$ , then  $n(A \cup B)$  is:  
(A) 75 (B) 55  
(C) 50 (D) 65
- If  $f(x) = (x - 1)/(x + 1)$ ,  $x \neq -1$ , then  $f(f(x))$  for  $x \neq 0$  equals:  
(A)  $1/x$  (B)  $-x$   
(C)  $-1/x$  (D)  $x$
- The modulus of the complex number  $(3 + 4i)(1 - i)$  is:  
(A) 7 (B)  $25\sqrt{2}$   
(C)  $5\sqrt{2}$  (D) 10
- If  $\omega$  is a non-real cube root of unity, then  $(1 + \omega - \omega^2)(1 - \omega + \omega^2)$  equals:  
(A) –4 (B) 0  
(C) 1 (D) 4
- The number of distinct arrangements of the letters of the word APPLE is:  
(A) 120 (B) 24  
(C) 30 (D) 60

6. There are 10 points in a plane, of which exactly 4 are collinear and no other three are collinear. The number of triangles that can be formed with these points as vertices is:  
 (A) 112 (B) 120  
 (C) 116 (D) 110
7. The term independent of  $x$  in the expansion of  $(x^2 + 1/x)^9$  is:  
 (A) 84 (B) 72  
 (C) 126 (D) 36
8. The arithmetic mean and geometric mean of two positive numbers are 10 and 8 respectively. The numbers are:  
 (A) 15 and 5 (B) 18 and 2  
 (C) 16 and 4 (D) 12 and 8
9. The value of  $1^2 + 2^2 + 3^2 + \dots + 10^2$  is:  
 (A) 330 (B) 385  
 (C) 285 (D) 505
10. If  $A = \begin{bmatrix} 2 & 3 \\ 1 & 2 \end{bmatrix}$ , then  $A^{-1}$  is:  
 (A)  $\begin{bmatrix} 2 & -3 \\ -1 & 2 \end{bmatrix}$  (B)  $\begin{bmatrix} -2 & 3 \\ 1 & -2 \end{bmatrix}$   
 (C)  $\begin{bmatrix} 2 & 3 \\ 1 & 2 \end{bmatrix}$  (D)  $\begin{bmatrix} 2 & -1 \\ -3 & 2 \end{bmatrix}$
11. The solution of the system  $x + y + z = 6$ ,  $x - y + z = 2$ ,  $2x + y - z = 1$  is:  
 (A)  $x = 2, y = 1, z = 3$  (B)  $x = 1, y = 2, z = 3$   
 (C)  $x = 1, y = 3, z = 2$  (D)  $x = 3, y = 2, z = 1$
12. If  $\alpha$  and  $\beta$  are the roots of  $2x^2 - 3x - 5 = 0$ , then  $1/\alpha + 1/\beta$  equals:  
 (A)  $-3/5$  (B)  $3/5$   
 (C)  $5/3$  (D)  $-5/3$
13. The equation  $x^2 + kx + 4 = 0$  has real roots if and only if:  
 (A)  $|k| \leq 4$  (B)  $|k| < 4$   
 (C)  $k \geq 4$  only (D)  $|k| \geq 4$
14. The number of solutions of  $2\sin^2 x - 3\sin x + 1 = 0$  in the interval  $[0, 2\pi]$  is:  
 (A) 3 (B) 4  
 (C) 1 (D) 2
15. The value of  $\tan^{-1}(1/2) + \tan^{-1}(1/3)$  is:  
 (A)  $\pi/6$  (B)  $\pi/2$   
 (C)  $\pi/4$  (D)  $\pi/3$
16. In a triangle with sides 5, 7 and 8 units, the angle opposite the side of length 7 is:  
 (A)  $45^\circ$  (B)  $60^\circ$   
 (C)  $30^\circ$  (D)  $90^\circ$
17. From the top of a tower 60 m high, the angle of depression of a car on the level ground is  $30^\circ$ . The distance of the car from the foot of the tower is:  
 (A)  $60\sqrt{3}$  m (B)  $20\sqrt{3}$  m  
 (C) 60 m (D)  $30\sqrt{3}$  m
18. The mean deviation about the mean of the data 3, 5, 7, 9, 11 is:  
 (A) 2.4 (B) 3.2  
 (C) 4 (D) 2

19. Two fair dice are thrown together. The probability that the sum of the numbers shown is 8 is:  
 (A)  $1/9$  (B)  $1/6$   
 (C)  $7/36$  (D)  $5/36$
20. Bag I has 3 red and 2 black balls; Bag II has 2 red and 3 black balls. A bag is chosen at random and a ball drawn from it is red. The probability that it came from Bag I is:  
 (A)  $1/2$  (B)  $2/5$   
 (C)  $3/5$  (D)  $3/10$
21. The mean and variance of a binomial distribution are 4 and 3 respectively. The number of trials  $n$  is:  
 (A) 24 (B) 8  
 (C) 12 (D) 16
22. The value of  $\lim_{x \rightarrow 0} (e^{2x} - 1)/x$  is:  
 (A) 2 (B)  $e^2$   
 (C)  $1/2$  (D) 1
23. For  $-1 < x < 1$ , the derivative of  $\sin^{-1}[2x/(1 + x^2)]$  with respect to  $x$  is:  
 (A)  $2/(1 + x^2)$  (B)  $2/\sqrt{1 - x^2}$   
 (C)  $1/(1 + x^2)$  (D)  $-2/(1 + x^2)$
24. If  $x^2 + y^2 = 25$ , then  $dy/dx$  at the point (3, 4) is:  
 (A)  $3/4$  (B)  $-3/4$   
 (C)  $-4/3$  (D)  $4/3$
25. The maximum value of  $\sin x + \cos x$  is:  
 (A)  $2\sqrt{2}$  (B)  $\sqrt{2}$   
 (C) 2 (D) 1
26. The equation of the tangent to the curve  $y = x^2$  at the point (1, 1) is:  
 (A)  $y = x$  (B)  $y = 2x + 1$   
 (C)  $y = -2x + 3$  (D)  $y = 2x - 1$
27.  $\int x e^x dx$  equals:  
 (A)  $e^x(x + 1) + C$  (B)  $e^x(x - 1) + C$   
 (C)  $x e^x + C$  (D)  $e^x(1 - x) + C$
28. The value of  $\int_0^1 x/(x^2 + 1) dx$  is:  
 (A)  $2 \ln 2$  (B)  $(1/2) \ln 3$   
 (C)  $(1/2) \ln 2$  (D)  $\ln 2$
29. The area of the region bounded by the curves  $y = x^2$  and  $y = x$  is:  
 (A)  $1/2$  sq. unit (B)  $1/3$  sq. unit  
 (C)  $2/3$  sq. unit (D)  $1/6$  sq. unit
30. The general solution of the differential equation  $dy/dx = y/x$  is ( $c$  an arbitrary constant):  
 (A)  $xy = c$  (B)  $y = cx^2$   
 (C)  $y = c + x$  (D)  $y = cx$
31. The integrating factor of the differential equation  $dy/dx + (2/x)y = x$  ( $x > 0$ ) is:  
 (A)  $1/x^2$  (B)  $e^x$   
 (C)  $2x$  (D)  $x^2$

32. The area of the triangle with vertices (1, 2), (4, 6) and (7, 2) is:  
 (A) 6 sq. units (B) 18 sq. units  
 (C) 24 sq. units (D) 12 sq. units
33. The acute angle between the lines  $y = 2x + 3$  and  $y = -3x + 1$  is:  
 (A)  $30^\circ$  (B)  $45^\circ$   
 (C)  $60^\circ$  (D)  $90^\circ$
34. The acute angle between the pair of lines  $x^2 - 5xy + 4y^2 = 0$  is:  
 (A)  $\tan^{-1}(3/5)$  (B)  $\tan^{-1}(5/3)$   
 (C)  $\tan^{-1}(3/4)$  (D)  $\pi/4$
35. The equation of the circle on the line joining (1, 2) and (3, 4) as a diameter is:  
 (A)  $x^2 + y^2 + 4x + 6y + 11 = 0$  (B)  $x^2 + y^2 - 4x - 6y + 11 = 0$   
 (C)  $x^2 + y^2 - 4x - 6y - 11 = 0$  (D)  $x^2 + y^2 - 2x - 3y + 11 = 0$
36. The line  $y = x + c$  touches the circle  $x^2 + y^2 = 8$  if  $c$  equals:  
 (A)  $\pm 2\sqrt{2}$  (B)  $\pm 4$   
 (C)  $\pm 2$  (D)  $\pm 8$
37. The eccentricity of the hyperbola  $x^2/16 - y^2/9 = 1$  is:  
 (A)  $5/3$  (B)  $5/4$   
 (C)  $4/5$  (D)  $\sqrt{7}/4$
38. The length of the latus rectum of the ellipse  $9x^2 + 16y^2 = 144$  is:  
 (A)  $9/4$  (B)  $8/3$   
 (C)  $9/2$  (D)  $32/3$
39. If  $a = \hat{i} + \hat{j}$ ,  $b = \hat{j} + \hat{k}$  and  $c = \hat{k} + \hat{i}$ , the scalar triple product  $[a \ b \ c]$  is:  
 (A)  $-2$  (B)  $2$   
 (C)  $1$  (D)  $0$
40. The perpendicular distance of the point (2, 1, -1) from the plane  $x - 2y + 2z = 5$  is:  
 (A)  $7/3$  (B)  $3/7$   
 (C)  $5/3$  (D)  $1$

## Part B

### Physics

41. The SI unit of the coefficient of viscosity is:  
 (A)  $\text{N s m}^{-2}$  (B)  $\text{N m s}^{-1}$   
 (C)  $\text{kg m s}^{-2}$  (D)  $\text{N m}^{-2} \text{s}^{-1}$
42. The position of a particle moving along the x-axis is  $x = t^3 - 6t^2 + 9t$  (x in m, t in s). Its acceleration at the instant it first comes to rest is:  
 (A) 0 (B)  $-6 \text{ m/s}^2$   
 (C)  $6 \text{ m/s}^2$  (D)  $-12 \text{ m/s}^2$
43. A full-wave rectifier is fed with 50 Hz alternating voltage. The fundamental frequency of the ripple in its output is:  
 (A) 200 Hz (B) 25 Hz  
 (C) 100 Hz (D) 50 Hz

44. A stone tied to a string 0.5 m long is whirled in a horizontal circle at 2 revolutions per second. Its centripetal acceleration is:  
 (A)  $2\pi^2 \text{ m/s}^2$  (B)  $4\pi^2 \text{ m/s}^2$   
 (C)  $16\pi^2 \text{ m/s}^2$  (D)  $8\pi^2 \text{ m/s}^2$
45. A man of mass 60 kg stands on a weighing machine in a lift moving upward with an acceleration of  $2 \text{ m/s}^2$ . Taking  $g = 10 \text{ m/s}^2$ , the machine reads:  
 (A) 600 N (B) 720 N  
 (C) 660 N (D) 480 N
46. The ratio of the wavelength of the first line of the Lyman series to that of the first line of the Balmer series of hydrogen is:  
 (A)  $5/27$  (B)  $4/9$   
 (C)  $3/4$  (D)  $27/5$
47. A ball moving with speed  $v$  collides head-on and elastically with an identical ball at rest. After the collision, the speeds of the first and second balls are:  
 (A)  $v/2$  and  $v$  (B)  $v/2$  and  $v/2$   
 (C) 0 and  $v$  (D)  $v$  and 0
48. The inductive reactance of a coil of inductance  $(1/\pi) \text{ H}$  in a 50 Hz AC circuit is:  
 (A)  $50 \Omega$  (B)  $314 \Omega$   
 (C)  $200 \Omega$  (D)  $100 \Omega$
49. A solid cylinder rolls without slipping on a horizontal surface. The fraction of its total kinetic energy that is rotational is:  
 (A)  $2/5$  (B)  $1/3$   
 (C)  $2/3$  (D)  $1/2$
50. If  $g$  is the acceleration due to gravity on the Earth's surface, its value at a height equal to the Earth's radius  $R$  is:  
 (A)  $g/4$  (B)  $g/2$   
 (C)  $2g$  (D)  $g/\sqrt{2}$
51. The radius of a satellite's circular orbit is made 4 times larger. Its period of revolution becomes:  
 (A) 16 times (B) 2 times  
 (C) 4 times (D) 8 times
52. Two wires of the same material have lengths in the ratio 1 : 2 and diameters in the ratio 2 : 1. They are stretched by equal forces. The ratio of their extensions is:  
 (A) 1 : 2 (B) 1 : 8  
 (C) 1 : 4 (D) 8 : 1
53. Nuclear radius  $R = R_0 A^{1/3}$ . The ratio of the radii of the nuclei  $^{27}\text{Al}$  and  $^{125}\text{Te}$  is:  
 (A) 9 : 25 (B) 27 : 125  
 (C) 5 : 3 (D) 3 : 5
54. The length of a simple pendulum is increased by 21%. Its time period increases by:  
 (A) 10% (B) 42%  
 (C) 11% (D) 21%

55. The speed of sound in air is 340 m/s. The fundamental frequency of a pipe 0.5 m long, closed at one end, is:  
 (A) 85 Hz (B) 680 Hz  
 (C) 340 Hz (D) 170 Hz
56. If the absolute temperature of a black body is doubled, the power it radiates becomes:  
 (A) 4 times (B) 2 times  
 (C) 16 times (D) 8 times
57. For one mole of an ideal monatomic gas, the ratio  $C_p/C_v$  is:  
 (A)  $3/2$  (B)  $4/3$   
 (C)  $7/5$  (D)  $5/3$
58. A point charge  $q$  is placed at the centre of a cube. The electric flux through any one face of the cube is:  
 (A)  $q/(3\epsilon_0)$  (B)  $q/\epsilon_0$   
 (C)  $q/(6\epsilon_0)$  (D)  $6q/\epsilon_0$
59. A capacitor of  $10\ \mu\text{F}$  is charged to a potential difference of 100 V. The energy stored in it is:  
 (A) 0.1 J (B) 5 J  
 (C) 0.5 J (D) 0.05 J
60. An object is placed 30 cm in front of a convex lens of focal length 20 cm. The image is formed at a distance of:  
 (A) 12 cm (B) 60 cm  
 (C) 30 cm (D) 40 cm
61. A cell of emf 2 V and internal resistance  $0.5\ \Omega$  is connected to an external resistance of  $3.5\ \Omega$ . The terminal voltage of the cell is:  
 (A) 1.5 V (B) 2 V  
 (C) 0.25 V (D) 1.75 V
62. A galvanometer of resistance  $99\ \Omega$  gives full-scale deflection for 1 mA. To convert it into an ammeter of range 0.1 A, the shunt needed is:  
 (A)  $9.9\ \Omega$  (B)  $0.99\ \Omega$   
 (C)  $10\ \Omega$  (D)  $1\ \Omega$
63. The current in a coil of self-inductance 0.5 H falls uniformly from 2 A to zero in 0.1 s. The magnitude of the induced emf is:  
 (A) 1 V (B) 10 V  
 (C) 5 V (D) 20 V
64. Unpolarised light falls on a glass surface (refractive index  $\sqrt{3}$ ) at the polarising (Brewster) angle. The angle of refraction is:  
 (A)  $90^\circ$  (B)  $60^\circ$   
 (C)  $30^\circ$  (D)  $45^\circ$
65. The de Broglie wavelength of an electron accelerated from rest through a potential difference of 100 V is about:  
 (A) 0.123 nm (B) 1.23 nm  
 (C) 0.0123 nm (D) 12.3 nm

## Chemistry

66. A compound contains 40% carbon, 6.67% hydrogen and 53.3% oxygen by mass. Its empirical formula is:
- (A)  $C_2H_2O$  (B)  $CH_2O$   
(C)  $CH_3O$  (D)  $CHO$
67. The number of radial nodes in a 3p orbital is:
- (A) 1 (B) 0  
(C) 3 (D) 2
68. The bond order of the  $O_2^+$  ion is:
- (A) 2 (B) 2.5  
(C) 1.5 (D) 3
69. Which of the following alkali metal carbonates decomposes on heating to give the metal oxide and  $CO_2$ ?
- (A)  $K_2CO_3$  (B)  $Na_2CO_3$   
(C)  $Li_2CO_3$  (D)  $Rb_2CO_3$
70. Which of the following is an interhalogen compound?
- (A)  $HClO_4$  (B)  $NaCl$   
(C)  $ClF_3$  (D)  $CCl_4$
71. As a result of the lanthanoid contraction, which pair of elements has almost identical atomic radii?
- (A) Cr and Mo (B) Ti and Zr  
(C) Zr and Hf (D) Sc and Y
72. An element crystallises in a body-centred cubic (bcc) lattice. The number of atoms per unit cell is:
- (A) 2 (B) 1  
(C) 6 (D) 4
73. The number of geometrical isomers of the square planar complex  $[Pt(NH_3)_2Cl_2]$  is:
- (A) 4 (B) 3  
(C) 2 (D) 0
74. In the van der Waals equation, the constant 'a' is a measure of the:
- (A) average kinetic energy of molecules  
(B) volume occupied by the molecules  
(C) rate of diffusion  
(D) intermolecular attractive forces
75. The freezing point of a 0.2 molal aqueous solution of NaCl (assume complete dissociation;  $K_f$  of water =  $1.86 \text{ K kg mol}^{-1}$ ) is:
- (A)  $-0.372^\circ\text{C}$  (B)  $-0.186^\circ\text{C}$   
(C)  $-0.744^\circ\text{C}$  (D)  $-1.488^\circ\text{C}$
76. Given  $E^\circ(Zn^{2+}/Zn) = -0.76 \text{ V}$ , the electrode potential of a zinc electrode dipped in  $0.01 \text{ M } Zn^{2+}$  solution at  $25^\circ\text{C}$  is (take  $2.303RT/F = 0.059 \text{ V}$ ):
- (A)  $-0.819 \text{ V}$  (B)  $-0.701 \text{ V}$   
(C)  $-0.790 \text{ V}$  (D)  $-0.760 \text{ V}$

77. A process is spontaneous at all temperatures when:  
 (A)  $\Delta H > 0$  and  $\Delta S < 0$  (B)  $\Delta H < 0$  and  $\Delta S < 0$   
 (C)  $\Delta H > 0$  and  $\Delta S > 0$  (D)  $\Delta H < 0$  and  $\Delta S > 0$
78. The solubility of AgCl in water at 25 °C is  $1 \times 10^{-5}$  mol L<sup>-1</sup>. Its solubility product is:  
 (A)  $1 \times 10^{-10}$  (B)  $2 \times 10^{-10}$   
 (C)  $1 \times 10^{-25}$  (D)  $1 \times 10^{-5}$
79. When the concentration of a reactant A is doubled, the rate of reaction becomes four times. The order of the reaction with respect to A is:  
 (A) 0 (B) 4  
 (C) 2 (D) 1
80. Which of the following species acts as an electrophile?  
 (A) NH<sub>3</sub> (B) BF<sub>3</sub>  
 (C) CN<sup>-</sup> (D) OH<sup>-</sup>
81. Natural rubber is a polymer of:  
 (A) chloroprene (B) styrene  
 (C) ethylene (D) isoprene
82. Ethyl bromide is heated with alcoholic KOH. The main organic product is:  
 (A) ethene (B) diethyl ether  
 (C) ethane (D) ethanol
83. Which of the following is the weakest base in aqueous solution?  
 (A) CH<sub>3</sub>NH<sub>2</sub> (B) (CH<sub>3</sub>)<sub>3</sub>N  
 (C) C<sub>6</sub>H<sub>5</sub>NH<sub>2</sub> (D) (CH<sub>3</sub>)<sub>2</sub>NH
84. Which of the following compounds gives a positive iodoform test?  
 (A) ethanol (B) methanol  
 (C) propan-1-ol (D) benzaldehyde
85. Which of the following is a greenhouse gas?  
 (A) methane (B) argon  
 (C) oxygen (D) nitrogen

## Part D

### Quantitative Aptitude

86. The price of sugar rises by 25%. By what percentage must a family reduce its consumption so that its expenditure on sugar stays the same?  
 (A) 20% (B) 30%  
 (C) 15% (D) 25%
87. If A : B = 2 : 3 and B : C = 4 : 5, then A : B : C is:  
 (A) 8 : 12 : 15 (B) 2 : 3 : 5  
 (C) 6 : 9 : 15 (D) 8 : 15 : 12
88. The cost price of 12 articles equals the selling price of 10 articles. The profit per cent is:  
 (A) 10% (B) 20%  
 (C) 25% (D) 16⅔%

89. The compound interest on ₹10,000 for 2 years at 10% per annum, compounded annually, is:  
(A) ₹1,900 (B) ₹2,210  
(C) ₹2,000 (D) ₹2,100
90. A can do a piece of work in 12 days and B can do it in 18 days. Working together, they can finish it in:  
(A) 15 days (B) 7.2 days  
(C) 8 days (D) 6 days
91. A train 200 m long running at 72 km/h crosses a platform 300 m long. The time taken is:  
(A) 15 s (B) 20 s  
(C) 25 s (D) 10 s
92. The average of five numbers is 20. If one number is removed, the average of the remaining four is 18. The number removed is:  
(A) 22 (B) 38  
(C) 20 (D) 28
93. Find the next number in the series: 2, 6, 12, 20, 30, ?  
(A) 40 (B) 48  
(C) 36 (D) 42
94. A 40-litre mixture contains milk and water in the ratio 3 : 1. How much water must be added to make the ratio 3 : 2?  
(A) 15 litres (B) 5 litres  
(C) 10 litres (D) 20 litres
95. A father is now three times as old as his son. After 12 years he will be twice as old as his son. The son's present age is:  
(A) 15 years (B) 10 years  
(C) 12 years (D) 18 years

## Part E

### English

96. Fill in the blanks with suitable articles: \_\_\_\_\_ Ganga is \_\_\_\_\_ holy river.  
(A) A, the (B) No article, a  
(C) The, a (D) The, the
97. Choose the word closest in meaning to DILIGENT.  
(A) intelligent (B) industrious  
(C) careless (D) indifferent
98. Choose the word opposite in meaning to HOSTILE.  
(A) unkind (B) aggressive  
(C) friendly (D) angry
99. Fill in the blank with the correct preposition: He was accused \_\_\_\_\_ theft.  
(A) for (B) of  
(C) with (D) on
100. Fill in the blank: Neither the teacher nor the students \_\_\_\_\_ present in the class yesterday.  
(A) were (B) has been  
(C) is (D) was

## Answer Key

|    |   |    |   |    |   |    |   |    |   |    |   |    |   |    |   |    |   |     |   |
|----|---|----|---|----|---|----|---|----|---|----|---|----|---|----|---|----|---|-----|---|
| 1  | B | 2  | C | 3  | C | 4  | D | 5  | D | 6  | C | 7  | A | 8  | C | 9  | B | 10  | A |
| 11 | B | 12 | A | 13 | D | 14 | A | 15 | C | 16 | B | 17 | A | 18 | A | 19 | D | 20  | C |
| 21 | D | 22 | A | 23 | A | 24 | B | 25 | B | 26 | D | 27 | B | 28 | C | 29 | D | 30  | D |
| 31 | D | 32 | D | 33 | B | 34 | A | 35 | B | 36 | B | 37 | B | 38 | C | 39 | B | 40  | A |
| 41 | A | 42 | B | 43 | C | 44 | D | 45 | B | 46 | A | 47 | C | 48 | D | 49 | B | 50  | A |
| 51 | D | 52 | B | 53 | D | 54 | A | 55 | D | 56 | C | 57 | D | 58 | C | 59 | D | 60  | B |
| 61 | D | 62 | D | 63 | B | 64 | C | 65 | A | 66 | B | 67 | A | 68 | B | 69 | C | 70  | C |
| 71 | C | 72 | A | 73 | C | 74 | D | 75 | C | 76 | A | 77 | D | 78 | A | 79 | C | 80  | B |
| 81 | D | 82 | A | 83 | C | 84 | A | 85 | A | 86 | A | 87 | A | 88 | B | 89 | D | 90  | B |
| 91 | C | 92 | D | 93 | D | 94 | C | 95 | C | 96 | C | 97 | B | 98 | C | 99 | B | 100 | A |

## Solutions

### Mathematics

- (B)  $n(A \cup B) = n(A) + n(B) - n(A \cap B) = 40 + 25 - 10 = 55$ .
- (C)  $f(f(x)) = [(x-1)/(x+1) - 1]/[(x-1)/(x+1) + 1] = [(x-1-x-1)/(x+1)]/[(x-1+x+1)/(x+1)] = -2/(2x) = -1/x$ .
- (C)  $|z_1 z_2| = |z_1| |z_2| = \sqrt{9+16} \times \sqrt{1+1} = 5\sqrt{2}$ .
- (D)  $1 + \omega + \omega^2 = 0$ , so  $1 + \omega = -\omega^2$  and  $1 + \omega^2 = -\omega$ . The product is  $(-2\omega^2)(-2\omega) = 4\omega^3 = 4$ .
- (D) 5 letters with P repeated twice:  $5!/2! = 120/2 = 60$ .
- (C) All choices of 3 points:  ${}^{10}C_3 = 120$ . Three of the 4 collinear points do not form a triangle:  ${}^4C_3 = 4$ . Triangles =  $120 - 4 = 116$ .
- (A)  $T(r+1) = {}^9C_r (x^2)^{9-r} (1/x)^r = {}^9C_r x^{18-3r}$ . For  $x^0$ ,  $r = 6$ , giving  ${}^9C_6 = 84$ .
- (C)  $a + b = 20$  and  $ab = 64$ , so they are the roots of  $t^2 - 20t + 64 = 0$ , i.e.  $t = 16$  and  $t = 4$ .
- (B)  $\sum n^2 = n(n+1)(2n+1)/6 = 10 \times 11 \times 21/6 = 385$ .
- (A)  $|A| = 4 - 3 = 1$ .  $A^{-1} = (1/|A|) \text{adj } A = [[2, -3], [-1, 2]]$ .
- (B) Subtracting the second equation from the first:  $2y = 4$ , so  $y = 2$ . Then  $x + z = 4$  and  $2x - z = -1$ ; adding gives  $3x = 3$ , so  $x = 1$  and  $z = 3$ .
- (A)  $\alpha + \beta = 3/2$  and  $\alpha\beta = -5/2$ , so  $1/\alpha + 1/\beta = (\alpha + \beta)/(\alpha\beta) = (3/2)/(-5/2) = -3/5$ .
- (D) Real roots need  $k^2 - 16 \geq 0$ , i.e.  $k \leq -4$  or  $k \geq 4$ , which is  $|k| \geq 4$ .
- (A)  $(2\sin x - 1)(\sin x - 1) = 0$ .  $\sin x = 1$  gives  $x = \pi/2$ ;  $\sin x = 1/2$  gives  $x = \pi/6$  and  $5\pi/6$ . Three solutions.
- (C)  $\tan^{-1}a + \tan^{-1}b = \tan^{-1}[(a+b)/(1-ab)]$  for  $ab < 1$ :  $(1/2 + 1/3)/(1 - 1/6) = (5/6)/(5/6) = 1$ , so the sum is  $\pi/4$ .
- (B)  $\cos \theta = (5^2 + 8^2 - 7^2)/(2 \times 5 \times 8) = (25 + 64 - 49)/80 = 40/80 = 1/2$ , so  $\theta = 60^\circ$ .
- (A)  $\tan 30^\circ = 60/d$ , so  $d = 60/(1/\sqrt{3}) = 60\sqrt{3}$  m.
- (A) Mean =  $35/5 = 7$ . Absolute deviations: 4, 2, 0, 2, 4; total 12. Mean deviation =  $12/5 = 2.4$ .
- (D) Favourable outcomes: (2, 6), (3, 5), (4, 4), (5, 3), (6, 2), i.e. 5 out of 36.
- (C) By Bayes' theorem:  $P(I | \text{red}) = (1/2 \times 3/5)/(1/2 \times 3/5 + 1/2 \times 2/5) = (3/10)/(5/10) = 3/5$ .
- (D)  $np = 4$  and  $npq = 3$  give  $q = 3/4$ , so  $p = 1/4$  and  $n = 4/(1/4) = 16$ .
- (A)  $(e^{2x} - 1)/x = 2 \times (e^{2x} - 1)/(2x) \rightarrow 2 \times 1 = 2$ .
- (A) Put  $x = \tan \theta$ :  $2x/(1+x^2) = \sin 2\theta$ , and for  $|x| < 1$ ,  $\sin^{-1}(\sin 2\theta) = 2\theta = 2\tan^{-1}x$ . Its derivative is  $2/(1+x^2)$ .
- (B)  $2x + 2y(dy/dx) = 0$ , so  $dy/dx = -x/y = -3/4$ .
- (B)  $\sin x + \cos x = \sqrt{2} \sin(x + \pi/4)$ , whose maximum is  $\sqrt{2}$ .

26. (D)  $dy/dx = 2x = 2$  at  $x = 1$ . Tangent:  $y - 1 = 2(x - 1)$ , i.e.  $y = 2x - 1$ .
27. (B) By parts:  $\int x e^x dx = x e^x - \int e^x dx = x e^x - e^x + C = e^x(x - 1) + C$ .
28. (C) Put  $u = x^2 + 1$ ,  $du = 2x dx$ :  $(1/2)\int_1^2 du/u = (1/2) \ln 2$ .
29. (D) The curves meet at  $x = 0$  and  $x = 1$ , with  $x \geq x^2$  between them. Area =  $\int_0^1 (x - x^2) dx = 1/2 - 1/3 = 1/6$ .
30. (D) Separating variables:  $dy/y = dx/x$ , so  $\ln y = \ln x + \ln c$ , i.e.  $y = cx$ .
31. (D) IF =  $e^{\int 2/x dx} = e^{2 \ln x} = x^2$ .
32. (D) The base from (1, 2) to (7, 2) is 6 units, and the height of (4, 6) above  $y = 2$  is 4 units. Area =  $(1/2) \times 6 \times 4 = 12$ .
33. (B)  $\tan \theta = |(m_1 - m_2)/(1 + m_1 m_2)| = |(2 + 3)/(1 - 6)| = 1$ , so  $\theta = 45^\circ$ .
34. (A) Here  $a = 1$ ,  $2h = -5$ ,  $b = 4$ .  $\tan \theta = 2\sqrt{(h^2 - ab)}/|a + b| = 2\sqrt{(25/4 - 4)}/5 = 2 \times (3/2)/5 = 3/5$ . (The lines are  $x = y$  and  $x = 4y$ .)
35. (B)  $(x - 1)(x - 3) + (y - 2)(y - 4) = 0$  gives  $x^2 - 4x + 3 + y^2 - 6y + 8 = 0$ , i.e.  $x^2 + y^2 - 4x - 6y + 11 = 0$ .
36. (B) Tangency needs the distance from the centre to the line to equal the radius:  $|c|/\sqrt{2} = 2\sqrt{2}$ , so  $|c| = 4$ .
37. (B)  $e = \sqrt{1 + b^2/a^2} = \sqrt{1 + 9/16} = \sqrt{25/16} = 5/4$ .
38. (C) Dividing by 144:  $x^2/16 + y^2/9 = 1$ , so  $a = 4$ ,  $b^2 = 9$ . Latus rectum =  $2b^2/a = 18/4 = 9/2$ .
39. (B)  $[a \ b \ c] = \det$  of rows (1, 1, 0), (0, 1, 1), (1, 0, 1) =  $1(1 - 0) - 1(0 - 1) + 0 = 2$ .
40. (A) Distance =  $|2 - 2 - 2 - 5|/\sqrt{1 + 4 + 4} = 7/3$ .

## Physics

41. (A) From  $F = \eta A(dv/dx)$ ,  $\eta = F/(A \times dv/dx)$ , with unit  $N/(m^2 \times s^{-1}) = N \ s \ m^{-2}$  (the pascal second).
42. (B)  $v = 3t^2 - 12t + 9 = 3(t - 1)(t - 3)$ , so it first stops at  $t = 1$  s.  $a = 6t - 12 = -6 \text{ m/s}^2$  at  $t = 1$  s.
43. (C) A full-wave rectifier gives one output pulse for each half cycle, so the ripple frequency is  $2 \times 50 = 100$  Hz.
44. (D)  $\omega = 2\pi \times 2 = 4\pi \text{ rad/s}$ .  $a = \omega^2 r = 16\pi^2 \times 0.5 = 8\pi^2 \text{ m/s}^2$ .
45. (B)  $N - mg = ma$ , so  $N = m(g + a) = 60 \times 12 = 720 \text{ N}$ .
46. (A) Lyman first line:  $1/\lambda = R(1 - 1/4) = 3R/4$ . Balmer first line:  $1/\lambda = R(1/4 - 1/9) = 5R/36$ .  $\lambda_L/\lambda_B = (5/36)/(3/4) = 5/27$ .
47. (C) For a one-dimensional elastic collision between equal masses, the velocities are exchanged: the first ball stops and the second moves on with speed  $v$ .
48. (D)  $X_L = 2\pi fL = 2\pi \times 50 \times (1/\pi) = 100 \ \Omega$ .
49. (B) Translational KE =  $(1/2)mv^2$ ; rotational KE =  $(1/2)(1/2 mR^2)(v/R)^2 = (1/4)mv^2$ . Total =  $(3/4)mv^2$ , so the rotational fraction is  $(1/4)/(3/4) = 1/3$ .
50. (A)  $g' = g R^2/(R + h)^2 = g R^2/(2R)^2 = g/4$ .
51. (D) By Kepler's third law  $T^2 \propto r^3$ , so  $T \propto r^{3/2} = 4^{3/2} = 8$ .
52. (B) Extension =  $FL/(AY) \propto L/d^2$ . Ratio =  $(1/2) \times (1/2)^2 = 1/8$ .
53. (D)  $R \propto A^{1/3}$ :  $27^{1/3} : 125^{1/3} = 3 : 5$ .
54. (A)  $T \propto \sqrt{L}$ .  $\sqrt{1.21} = 1.1$ , so  $T$  increases by 10%.
55. (D) For a pipe closed at one end,  $f_1 = v/(4L) = 340/(4 \times 0.5) = 170 \text{ Hz}$ .
56. (C) By Stefan's law  $P \propto T^4$ , so  $2^4 = 16$  times.
57. (D) A monatomic gas has 3 degrees of freedom:  $C_v = (3/2)R$ ,  $C_p = (5/2)R$ , so  $\gamma = 5/3$ .
58. (C) By Gauss's law the total flux is  $q/\epsilon_0$ . By symmetry it divides equally among the 6 faces:  $q/(6\epsilon_0)$ .
59. (D)  $U = (1/2)CV^2 = (1/2) \times 10 \times 10^{-6} \times 10^4 = 0.05 \text{ J}$ .
60. (B)  $1/v - 1/u = 1/f$  with  $u = -30 \text{ cm}$ ,  $f = +20 \text{ cm}$ :  $1/v = 1/20 - 1/30 = 1/60$ , so  $v = +60 \text{ cm}$  (real image on the other side).
61. (D)  $I = E/(R + r) = 2/4 = 0.5 \text{ A}$ . Terminal voltage  $V = E - Ir = 2 - 0.25 = 1.75 \text{ V}$ .
62. (D)  $S = I_g G/(I - I_g) = (0.001 \times 99)/(0.1 - 0.001) = 0.099/0.099 = 1 \ \Omega$ .
63. (B)  $|e| = L(\Delta I/\Delta t) = 0.5 \times (2/0.1) = 10 \text{ V}$ .

64. (C)  $\tan i_p = \mu = \sqrt{3}$ , so  $i_p = 60^\circ$ . At the Brewster angle the reflected and refracted rays are perpendicular, so  $r = 90^\circ - 60^\circ = 30^\circ$ .

65. (A)  $\lambda = 1.227/\sqrt{V} \text{ nm} = 1.227/10 \approx 0.123 \text{ nm}$  (1.23 Å).

## Chemistry

66. (B) Moles: C =  $40/12 = 3.33$ , H =  $6.67/1 = 6.67$ , O =  $53.3/16 = 3.33$ . Ratio 1 : 2 : 1, so  $\text{CH}_2\text{O}$ .

67. (A) Radial nodes =  $n - l - 1 = 3 - 1 - 1 = 1$ .

68. (B)  $\text{O}_2^+$  has 15 electrons: bonding 10, antibonding 5. Bond order =  $(10 - 5)/2 = 2.5$ .

69. (C) The small  $\text{Li}^+$  ion polarises the large carbonate ion, so  $\text{Li}_2\text{CO}_3$  decomposes on heating to  $\text{Li}_2\text{O}$  and  $\text{CO}_2$ . The carbonates of Na, K and Rb are stable to heat.

70. (C) Interhalogen compounds contain only two different halogens.  $\text{ClF}_3$  (chlorine and fluorine) is one; the others contain non-halogen elements.

71. (C) The poor shielding by 4f electrons makes the 5d elements nearly the same size as the 4d elements above them, so Zr (160 pm) and Hf (159 pm) are almost identical.

72. (A) 8 corners  $\times 1/8$  + 1 body centre  $\times 1 = 2$  atoms per unit cell.

73. (C) A square planar  $\text{MA}_2\text{B}_2$  complex has cis and trans forms: 2 geometrical isomers.

74. (D) The term  $a/V^2$  corrects the pressure for the attraction between molecules; 'b' corrects for the volume of the molecules.

75. (C)  $\Delta T_f = iK_f m = 2 \times 1.86 \times 0.2 = 0.744 \text{ K}$ , so the freezing point is  $-0.744^\circ\text{C}$ .

76. (A) For  $\text{Zn}^{2+} + 2e^- \rightarrow \text{Zn}$ :  $E = E^\circ - (0.059/2) \log(1/[\text{Zn}^{2+}]) = -0.76 - 0.0295 \times 2 = -0.819 \text{ V}$ .

77. (D)  $\Delta G = \Delta H - T\Delta S$ . With  $\Delta H$  negative and  $\Delta S$  positive,  $\Delta G$  is negative at every temperature.

78. (A)  $\text{AgCl} \rightleftharpoons \text{Ag}^+ + \text{Cl}^-$ , so  $K_{sp} = s \times s = (1 \times 10^{-5})^2 = 1 \times 10^{-10}$ .

79. (C) Rate  $\propto [\text{A}]^n$ , so  $2^n = 4$  and  $n = 2$ .

80. (B)  $\text{BF}_3$  has an incomplete octet on boron and accepts an electron pair, so it is an electrophile (Lewis acid).  $\text{NH}_3$ ,  $\text{OH}^-$  and  $\text{CN}^-$  have lone pairs to donate and act as nucleophiles.

81. (D) Natural rubber is cis-1,4-polyisoprene (2-methylbuta-1,3-diene). Chloroprene gives the synthetic rubber neoprene.

82. (A) Alcoholic KOH brings about dehydrohalogenation ( $\beta$ -elimination):  $\text{CH}_3\text{CH}_2\text{Br} \rightarrow \text{CH}_2=\text{CH}_2 + \text{HBr}$ . Aqueous KOH would give ethanol.

83. (C) In aniline the nitrogen lone pair is delocalised into the benzene ring, so it is far less available for protonation than in the aliphatic amines.

84. (A) The iodoform test needs a  $\text{CH}_3\text{CO}-$  group or a  $\text{CH}_3\text{CH}(\text{OH})-$  group. Ethanol ( $\text{CH}_3\text{CH}_2\text{OH}$ ) is oxidised to  $\text{CH}_3\text{CHO}$  and gives yellow  $\text{CHI}_3$ ; the others lack this group.

85. (A) Methane absorbs infrared radiation and is a strong greenhouse gas.  $\text{N}_2$ ,  $\text{O}_2$  and Ar do not absorb infrared significantly.

## Quantitative Aptitude

86. (A) New price = 1.25 times. Consumption must become  $1/1.25 = 0.8$  times, a reduction of 20%.

87. (A) Make B the same: A : B = 8 : 12 and B : C = 12 : 15, so A : B : C = 8 : 12 : 15.

88. (B) Let CP of one article = ₹1. SP of 10 = CP of 12 = ₹12, so SP of one = ₹1.20. Profit = 20%.

89. (D) Amount =  $10,000 \times 1.1^2 = ₹12,100$ , so CI = ₹2,100 (₹100 more than simple interest).

90. (B) Together per day:  $1/12 + 1/18 = (3 + 2)/36 = 5/36$ . Time =  $36/5 = 7.2$  days.

91. (C) 72 km/h = 20 m/s. Distance = 200 + 300 = 500 m. Time =  $500/20 = 25$  s.

92. (D) Total of five = 100; total of four = 72. Removed number =  $100 - 72 = 28$ .

93. (D) The terms are  $1 \times 2$ ,  $2 \times 3$ ,  $3 \times 4$ ,  $4 \times 5$ ,  $5 \times 6$ , so the next is  $6 \times 7 = 42$  (differences 4, 6, 8, 10, 12).

94. (C) Milk = 30 L, water = 10 L. For 3 : 2, water must be 20 L, so 10 L of water must be added.

95. (C) Let the son be x:  $3x + 12 = 2(x + 12)$ , so  $x = 12$  years (father 36).

- 96. (C)** Names of rivers take 'the' (the Ganga); 'a holy river' is one of many, so it takes 'a'.
- 97. (B)** Diligent means hard-working and careful. Industrious has the same meaning; indifferent and careless are nearly opposite.
- 98. (C)** Hostile means unfriendly or opposed. Its opposite is friendly; the other options are close to hostile in meaning.
- 99. (B)** The verb 'accuse' takes 'of': to accuse someone of something.
- 100. (A)** With 'neither ... nor', the verb agrees with the nearer subject, 'the students' (plural); the past time needs 'were'.