PACE-IIT & MEDICAL

MUMBAI / DELHI-NCR / PUNE / HYDERABAD / AKOLA / GOA / JALGOAN / BOKARO / AMRAVATI / PATNA / BARAMATI

IIT – JEE: 2027 **MAJOR TEST - 1** **DATE: 26/07/25**

ANSWER KEY

MATHEMATICS

Q. No.	1	2	3	4	5	6	7	8	9	10
Ans.	B	B	D	A	A	B	C	D	B	C
Q. No.	11	12	13	14	15	16	17	18	19	20
Ans.	C	B	C	B	A	C	C	B	B	C
Q. No.	21	22	23	24	25					
Ans.	3	0	8	3	70					

PHYSICS

Q. No.	26	27	28	29	30	31	32	33	34	35
Ans.	B	A	B	A	B	B	C	C	B	B
Q. No.	36	37	38	39	40	41	42	43	44	45
Ans.	C	A	D	A	C	C	A	B	B	A
Q. No.	46	47	48	49	50					
Ans.	24	25	45	5	75					

CHEMISTRY

Q. No.	51	52	53	54	55	56	57	58	59	60
Ans.	D	B	D	D	D	C	D	C	A	B
Q. No.	61	62	63	64	65	66	67	68	69	70
Ans.	A	A	D	B	A	A	B	D	D	C
Q. No.	71	72	73	74	75					
Ans.	4	5	6	0	6					

PART (A) : MATHEMATICS

1. (B)

Let roots are α and $\frac{1}{\alpha}$, than

$\alpha \cdot \frac{1}{\alpha} = \frac{k+2}{2k+1} \Rightarrow \frac{k+2}{2k+1} \Rightarrow k = 1$

2. (B)

According to the given conditions, p and q are roots of equation $3x^2 - 5x - 2 = 0$.

Therefore $p.q = -\frac{2}{3}$.

3. (D)

Given $\alpha + \beta = 3p, \alpha\beta = p^2, \alpha^2 + \beta^2 = \frac{7}{4}$ so, $(\alpha+\beta)^2 - 2\alpha\beta = \frac{7}{4}$

$\Rightarrow \quad 9p^2 - 2p^2 = \frac{7}{4} \Rightarrow p = \pm\frac{1}{2}$

Hence (D) is the correct answer.

4. (A)

Given equation $2ax^2 + (2a+b)x + b = 0, (a \neq 0)$

Now its discriminate $D = B^2 - 4AC$

$= (2a+b)^2 - 4.2ab = (2a-b)^2$

Hence D is perfect square, so given equation has rational roots.

5. (A)

$-1 \le \sin x \le 1$

$6 \le 7 - \sin x \le 8$

$\frac{1}{8} \le \frac{1}{7-\sin x} \le \frac{1}{6}$

$\left[\frac{1}{8}, \frac{1}{6}\right]$

6. (B)

Let $f(x) = \sin x \cos x = \frac{1}{2}\sin 2x$

We know $-1 \le \sin 2x \le 1 \Rightarrow -\frac{1}{2} \le \frac{1}{2}\sin 2x \le \frac{1}{2}$

Thus the greatest and least value of $f(x)$ are $\frac{1}{2}$ and $-\frac{1}{2}$ respectively

7. (C)

$1 > 95 - 30\pi > 63 - 20\pi$

$\sin 1 > \sin 95 > \sin 63$

8. (D)

$$\sqrt{1+\sin 36^\circ} = \sqrt{\sin^2 18^\circ + \cos^2 18^\circ + 2\sin 18^\circ \cos 18^\circ}$$

$$= \sin 18^\circ + \cos 18^\circ = \sqrt{2}\left[\sin\left(45^\circ + 18^\circ\right)\right]$$

$$= \sqrt{2}\sin 63^\circ$$

$$= \sqrt{2}\cos 27^\circ = \sqrt{2}\sqrt{1-p^2} = \sqrt{2-2p^2}$$

9. (B)

$$\frac{\sin(\theta+2\alpha)}{\sin\theta} = \frac{3}{2}$$

Apply componendo & dividend

$$\Rightarrow \quad \frac{\sin(\theta+2\alpha)+\sin\theta}{\sin(\theta+2\alpha)-\sin\theta} = \frac{3+2}{3-2}$$

$$\Rightarrow \quad \tan(\theta+\alpha)\cdot\cot\alpha = 5$$

10. (C)

$$\frac{-2\sin 2\theta\cos 4\theta + 2\sin 4\theta\sin 2\theta}{\sin 4\theta - \cos 4\theta}$$

$$= 2\sin 2\theta$$

$$= 2\sin 54$$

$$= 2\cos 36$$

11. (C)

$$\text{L.H.S.} = \frac{\sin\left(70^\circ - 20^\circ\right)}{\cos 70^\circ \cos 20^\circ} = \frac{\sin 50^\circ}{\sin 20^\circ \cos 20^\circ}$$

$$= \frac{2\sin 50^\circ}{\sin 40^\circ} = \frac{2\sin 50^\circ}{\cos 50^\circ} = 2\tan 50^\circ$$

12. (B)

$$\frac{\sin 2\alpha + \sin 4\alpha - \sin 3\alpha}{\cos 2\alpha + \cos 4\alpha - \cos 3\alpha}$$

$$= \frac{2\sin 3\alpha\cos\alpha - \sin 3\alpha}{2\cos 3\alpha\cos\alpha - \cos 3\alpha}$$

$$= \frac{\sin 3\alpha(2\cos\alpha - 1)}{\cos 3\alpha(2\cos\alpha - 1)} = \tan 3\alpha$$

13. (C)

$$\sin(\alpha+\beta) = 1 \rightarrow \alpha+\beta = \frac{\pi}{2}$$

$$\sin(\alpha-\beta) = \frac{1}{2} \Rightarrow \alpha-\beta = \frac{\pi}{6}$$

$$\therefore \quad \alpha = \frac{\pi}{3}, \beta = \frac{\pi}{6}$$

$$\therefore \quad \tan(\alpha+2\beta)\tan(2\alpha+\beta) = \tan\frac{2\pi}{3}\cdot\tan\frac{5\pi}{6} = 1$$

14. (B)

Maximum value is $\frac{-D}{4a}=\frac{-\left(4^2-4\cdot(-4)\cdot 5\right)}{4\cdot(-4)}\approx 6$

15. (A)

$x^2-2kx+k^2+k-5=0$

$D\geq 0$

$4k^2-4\left(k^2+k-5\right)\geq 0$ … (i)

$\Rightarrow \quad k\leq 5$

Roots are less than, 5

$\Rightarrow \quad f(5)>0$

$\Rightarrow \quad 25-10k+k^2+k-5>0$

$\Rightarrow \quad k\in(-\infty,4)\cup(5,\infty)$ … (ii)

$-\frac{b}{2a}<5$ … (iii)

$\Rightarrow \quad k<5$

From (i), (ii) and (iii), $k\in(-\infty,4)$

16. (C)

The conditions for both the rots of the equation $f(x)=0$, where $ax^2+bx+c=f(x)$ to be greater than a given number k are $b^2-4ac\geq 0$, af $(k)>0, \frac{-b}{2a}>k$ Hence $f(x)=x^2+x+a$. Therefore both roots will exceed a, if

(i) $1-4a>0$ (ii) $f(a)>0$ (iii) $-\frac{1}{2}>a$

17. (C)

$x^2-2(3k-1)x+8k^2-7>0$

Now, $D<0$

$\Rightarrow \quad 4(3k-1)^2-4\times 1\times\left(8k^2-7\right)<0$

$\Rightarrow \quad 9k^2-6k+1-8k^2+7<0$

$\Rightarrow \quad k^2-6k+8<0$

$\Rightarrow \quad (k-4)(k-2)<0$

$2<k<4$

Then $k=3$

18. (B)

$\left(\cos 12^\circ+\cos 84^\circ\right)-\left(\cos 24^\circ+\cos 48^\circ\right)$

$=2\cos 48^\circ\ \cos 36^\circ-2\cos 36^\circ\ \cos 12^\circ=2\cos 36^\circ\left(\cos 48^\circ-\cos 12^\circ\right)$

$=2\cos 36^\circ\left(2\sin 30^\circ\sin(-18)\right)=-2\cos 36^\circ\sin 18^\circ=-2\left(\frac{\sqrt{5}+1}{4}\right)\left(\frac{\sqrt{5}-1}{4}\right)=-\frac{1}{2}$

19. (B)

$$\text{Angle} = \frac{\text{arc}}{\text{raaius}} = \frac{15}{(3/4)}\text{cm}$$

$\Rightarrow$ Radius = 20 cm

20. (C)

$$\sin\frac{\pi}{10}\sin\frac{3\pi}{10} = \sin 18^\circ \cdot \sin 54^\circ$$

$$= \sin 18^\circ \cdot \cos 36^\circ = \frac{\sqrt{5}-1}{4}\cdot\frac{\sqrt{5}+1}{4} = \frac{1}{4}$$

21. (3)

Let α and 3 are the roots of the equation $x^2 + ax + 3 = 0$

$\therefore \quad 3\alpha = 3 \quad \Rightarrow \alpha = 1$

And $3 + \alpha = -a \Rightarrow a = -4$

Again, let β and 3β are the roots of the equation

$x^2 + ax + b = 0$

$\therefore \quad \beta + 3\beta = 4\beta = -a \Rightarrow \beta = 1$

And $\beta.3\beta = b \Rightarrow b = 3$

22. (0)

Given equations are $2x^2 + 3x + 5\lambda = 0$ and $x^2 + 2x + 3\lambda = 0$ have a common root, if

$$\frac{x^2}{(9-10)\lambda} = \frac{x}{(5-6)\lambda} = \frac{1}{(4-3)}$$

$$\Rightarrow \quad \frac{x^2}{-\lambda} = \frac{x}{-\lambda} = \frac{1}{1}$$

$\Rightarrow \quad x^2 = -\lambda, x = -\lambda$ or $\lambda = -1, 0$

23. (8)

$7\cos x = 9\cos y$

$$\frac{\cos x}{\cos y} = \frac{9}{7}$$

$$\frac{\cos x + \cos y}{\cos x - \cos y} = \frac{9+7}{9-7}$$

$$\frac{2\cos\left(\frac{x+y}{2}\right)\cos\left(\frac{x-y}{2}\right)}{2\sin\left(\frac{x+y}{2}\right)\sin\left(\frac{y-x}{2}\right)} = 8$$

$$\left|\cot\left(\frac{x+y}{2}\right)\cot\left(\frac{x-y}{2}\right)\right| = 8$$

24. (3)

$$16\cdot\cos 10^\circ \cos\left(60^\circ - 10^\circ\right)\cos\left(60^\circ + 10^\circ\right)\cdot\sin\left(180^\circ - 60^\circ\right)$$

$$= 16\cdot\left(\frac{1}{4}\cos 30^\circ\right)\left(\sin 60^\circ\right) = 4\times\frac{\sqrt{3}}{2}\times\frac{\sqrt{3}}{2} = 3$$

25. (70)

$\left(\sin 6^\circ \sin 54^\circ \sin 66^\circ\right)\sin 42^\circ \sin 78^\circ$

$\Rightarrow \quad \frac{1}{4}\left(\sin 18^\circ \sin 42^\circ \sin 78^\circ\right)$

$\Rightarrow \quad \frac{1}{16}\sin 54^\circ = \frac{\sqrt{5}+1}{64}$

PART (B) : PHYSICS

26. (B)

Given: $u = 0, a = 2m/s^2, t = 5s$

To Find: Final velocity v

$v = u + at = 0 + 2 \times 5 = 10 m/s$

27. (A)

Given: Equal distances in equal intervals of time

Explanation: This implies constant speed $\Rightarrow$ acceleration is zero

28. (B)

Concept: Slope of a displacement-time graph gives velocity.

Straight line ⇒ constant slope ⇒ uniform velocity.

29. (A)

Dimension check: Velocity has units LT^{-1}

Option A: $at \Rightarrow LT^{-2} \cdot T = LT^{-1} \Rightarrow$ Correct

30. (B)

Concept: Area under v-t graph gives displacement

31. (B)

$u = 20, v = 0$ at top, $g = 10$

$v = u - gt \Rightarrow 0 = 20 - 10t \Rightarrow t = 2s$

32. (C)

Concept: Displacement = final position – Initial position. Same point $\Rightarrow$ displacement = 0

33. (C)

Explanation: Displacement is a vector and can be negative depending on direction.

Speed, distance, and mass are always ≥ 0.

34. (B)

Let distance between A ands B = d

Total time taken $= \frac{d}{20} + \frac{d}{30}$

Average speed $= \frac{2d}{\frac{d}{20} + \frac{d}{30}} = 24$ km/h

35. (B)

Let bus travels a distance x.

In the same time, cyclist will travel (96 + x).

Cyclist,

$$s = ut + \frac{1}{2}at^2$$

$$96 + x = 20t \qquad ...(i)$$

Bus,

$$s = ut + \frac{1}{2}at^2$$

$$x = \frac{1}{2}(2)t^2 \qquad ...(ii)$$

Solving Eqs. (i) and (ii), we get

$t = 8\,s$ and $t = 12\,s$

36. (C)

$$T = \frac{2u\sin\theta}{g\cos\alpha} = \frac{2\times 20\times\sin 90°}{10(\cos 37°)}$$

$$T = 5\,s$$

$$S_x = u_x t + \frac{1}{2}a_x t^2$$

$$R = 0 + \frac{1}{2}(10\sin 37°)(5)^2$$

$$R = 75\,m$$

37. (A)

$$\mathbf{u} = u\cos\theta\,\hat{\mathbf{i}} + u\sin\theta\,\hat{\mathbf{j}}$$

$$\mathbf{v} = u\cos\theta\,\hat{\mathbf{i}}$$

$$\mathbf{v}_{avg} = \frac{\mathbf{v}+\mathbf{u}}{2} = u\cos\theta\,\hat{\mathbf{i}} + \frac{u\sin\theta}{2}\hat{\mathbf{j}}$$

$$\mathbf{v}_{avg} = 8\hat{\mathbf{i}} + 3\hat{\mathbf{j}}$$

$\Rightarrow \quad u\cos\theta = 8$

$\Rightarrow \quad u\sin\theta = 6$

$\Rightarrow \quad \tan\theta = \frac{3}{4}$

38. (D)

Displacement, velocity, and force are vectors. Work is scalar (dot product).

39. (A)

$$\vec{A} = 6\hat{i} - 8\hat{j}$$

Magnitude $= \sqrt{36+64} = 10$

Unit vector $= \frac{1}{10}(6\hat{i} - 8\hat{j}) = \frac{3}{5}\hat{i} - \frac{4}{5}\hat{j}$

40. (C)

$$\frac{d}{dx}\left(\sqrt{1+\sin 2x}\right)$$

$$= \frac{d}{dx}\left(\sqrt{\sin^2 x+\cos^2 x+2\sin x\cos x}\right)$$

$$= \frac{d}{dx}\left(\sqrt{(\sin x+\cos x)^2}\right)$$

$$= \frac{d}{dx}(\sin x+\cos x) = \cos x-\sin x$$

41. (C)

$\vec{i}$ and $\vec{j}$ are perpendicular, angle $= 90^\circ$

42. (A)

$$x = t^2 \Rightarrow v = \frac{dx}{dt} = 2t$$

43. (B)

Acceleration $= \frac{d^2x}{dt^2}$ by definition.

44. (B)

$v = 3t^2 \Rightarrow x = \int 3t^2 dt = t^3 + C$, since x = 0 at t = 0 $\Rightarrow$ C = 0 $\therefore$ $x = t^3$

45. (A)

$$\int \frac{5}{3x-7}\,dx = \frac{5}{3}\ln|3x-7| + C$$

46. (24)

$a = 3, t = 4$

$$s = \frac{1}{2}at^2 = \frac{1}{2}\cdot 3\cdot 16 = 24\text{ m}$$

47. (25)

$v = 20, s = 500$

$$t = \frac{s}{v} = \frac{500}{20} = 25\text{ s}$$

48. (45)

$u = 30, g = 10$

$$h = \frac{u^2}{2g} = \frac{900}{20} = 45\text{m}$$

49. (5)

$\vec{A} = 2\hat{i}+3\hat{j},\ \vec{B} = 4\hat{i}-\hat{j}$

$\vec{A}\cdot\vec{B} = 2\cdot 4+3\cdot(-1) = 8-3 = 5$

50. (75)

$v = 6t$

$x = \int_0^5 6t\,dt = \left[3t^2\right]_0^5 = 75m$

PART (C) : CHEMISTRY

51. (D)

$Mg_{24} \rightarrow 48g \rightarrow 2mole \rightarrow$

1 mole Mg $\rightarrow$ $12e^- \times N_A$

1 mole $Mg^{2+} = 10e^- \times N_A$ (Avogadro number)

2 mole $Mg \rightarrow 24e^- \times N_A$

2 mole $Mg^{2+} = 20^{e-} \times N_4$

52. (B)

Composition of the compound is fixed irrespective of source. Law of definite proportion.

53. (D)

54. (D)

$\boxed{\begin{matrix} SI \rightarrow corrcet \\ SII \rightarrow corrcet \end{matrix}} \rightarrow$ Pure water $\rightarrow \underset{(1000\ ml)}{1L}$, 1000g,

$$n = \frac{1000}{18} \qquad M = \frac{n}{L} = \frac{1000}{\frac{18}{1}} = 55.55$$

$\Rightarrow$ with temperature volume increase $\rightarrow$ conc. changes.

55. (D)

$\left.\begin{matrix} H_2SO_4 \rightarrow SO_4^{2-} + 2H^+ \\ H_3PO_3 \rightarrow HPO_3^{-2} + 2H^+ \end{matrix}\right\}$ dibasic acids

$\left.2HNO_3 \rightarrow 2H^+ + 2NO_3^{1-}\right\}$ monobasic acid

56. (C)

For NaOH

$C = \frac{n}{V} \quad \therefore 1 = \frac{n}{25/1000} = n_{NaOH} = \frac{25}{1000} = n_{HCl}$

NaOH & HCl both mono acidic base & monobasic acid

$C_{HCl} = \frac{n_{HCl}}{v_{HCl}} = \frac{25/1000}{10/1000} = 2.5M$

57. (D)

$'n' \rightarrow 3 \rightarrow$ no. of period. $P \rightarrow$ last e^- goes in 3P.

GP = 12 + no. of e^- in $P = 12 + 4$ element is (s) = 16

58. (C)

As and Bi are in the same group.

59. (A)
Anions are larger in size than atoms as we go from $L \rightarrow R$ atomic size decreases

60. (B)
Half filled configuration more stable large energy required to remove electron.

61. (A)
IE value $\downarrow$ down the group
$IE \propto \frac{1}{size}$

62. (A)

63. (D)
$n = \frac{0}{1}, \alpha = \frac{2}{4}, p = \frac{1}{1}, e\frac{1}{1/1837}$

64. (B)

65. (A)
$\Rightarrow \quad Mass = 10^{-10} g = 10^{-13} kg$
$\Rightarrow \quad \Delta v = \frac{0.0001}{100} \times 10^{-13} \times 10^{-2} = 10^{-14} m\ sec^{-1}$
$\Delta x \cdot \Delta p = \frac{h}{4\pi} \qquad \therefore \Delta x = \frac{h}{4\pi \Delta p} = \frac{b}{4\pi\ m\ \Delta V}$
$\Delta x = 6.62 \times 10^{-34}$
$4 \times 3.14 \times 10^{-13} \times 10^{-14} = 5.2 \times 10^{-8} m$

66. (A)
$n + \ell$ rule $\rightarrow$ $6s \rightarrow 6+0=6 \qquad$ 'n' - higher $5d = 5+2 = 7$
$4f \rightarrow 4+3=7 \qquad$ 'n' higher $6p = 6+1 = 7$

67. (B)

68. (D)
$\sqrt{\ell(\ell+1)}\frac{h}{2\pi}$
$p = \ell = 1$
$= \sqrt{1(2)}\frac{b}{2\pi}$

69. (D)

70. (C)

71. (4)
Electronic configuration for $\underset{46}{Pd} \rightarrow \underbrace{1s^2 2s^2 2p^6}_{10}\underbrace{3s^2 3p^6 4s^2}_{20}\ \underset{30}{3d^{10}}\ \underset{6}{4p^6}$
$n = 4.$ $\qquad 5s^0 4d^{10}$

72. (5)

73. (6)

Ignore wt. of stock wrt solution $\rightarrow$ wt. of solvent can be taken

$$\text{ppm} = \frac{\text{Weight of solvent}}{\text{Weight of solution}} \times 10^6$$

$$= \frac{6 \times 10^{-5}}{10} \times 10^6 = 6 \text{ ppm}$$

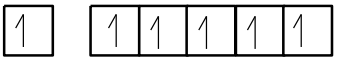
74. (0)

Zero, $\ell = 0$

75. (6)

Sc	Tl	V	Cr
$4s^2$	$4s^2$	$4s^2$	$4s^1$
$3d^1$	$3d^2$	$3d^3$	$3d^5$

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d$ s



6 unpaired e^-