CLASSROOM CONTACT PROGRAMME

JEE(Main + Advanced) : LEADER TEST SERIES / JOINT PACKAGE COURSE

Test Type : Mock Test

ANSWER KEY — PAPER-2

PART-1 : PHYSICS

SECTION-I (i)	Q.	1	2	3	4				
	A.	C	B	A	A				
SECTION-I (ii)	Q.	5	6	7	8				
	A.	A,C	A,D	A,B,C	A,D				
SECTION-II	Q.	1	2	3	4	5	6	7	8
	A.	5.00	2.00	6.00	10.00	2.00	2.00	8.00	1.00

PART-2 : CHEMISTRY

SECTION-I (i)	Q.	1	2	3	4				
	A.	B	D	C	A				
SECTION-I (ii)	Q.	5	6	7	8				
	A.	B,C,D	A,B,D	A,B,D	A,B,C,D				
SECTION-II	Q.	1	2	3	4	5	6	7	8
	A.	4.00	5.00	2.00	4.00	8.00	7.00	4.00	5.00

PART-3 : MATHEMATICS

SECTION-I (i)	Q.	1	2	3	4				
	A.	C	B	B	D				
SECTION-I (ii)	Q.	5	6	7	8				
	A.	A,B,C,D	A,B,D	A,D	A,D				
SECTION-II	Q.	1	2	3	4	5	6	7	8
	A.	0.28	3.00	2016.00	1062.00	7.00	0.75	7.07	7.00

HINT – SHEET

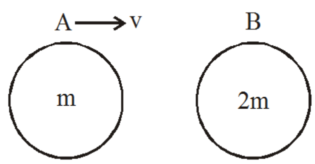
PART-1 : PHYSICS

SECTION-I (i)

1. Ans (C)

Coefficient of restitution is the ratio of velocity of separation to velocity of approach along the line of impact

2. Ans (B)



For maximum loss in kinetic energy of 'A'

Final velocity of 'A' = 0

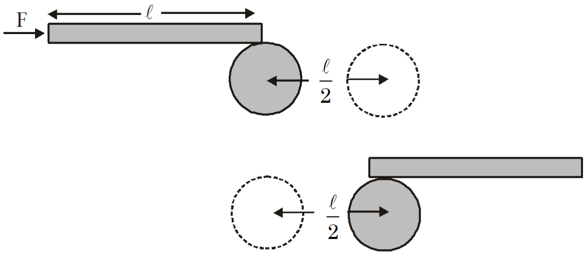
$\Rightarrow P_i = P_f$

$mv = 0 + 2mv'$

$v' = \frac{v}{2}$

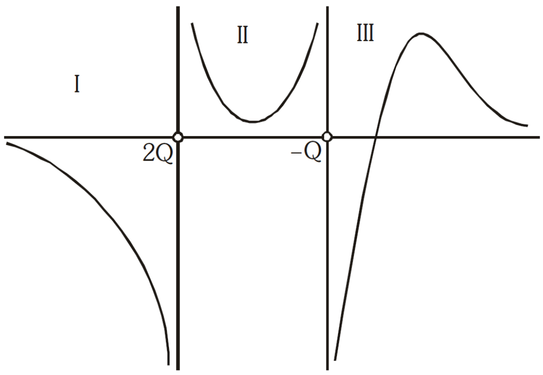
$e = \frac{\frac{v}{2} - 0}{v} = \frac{1}{2} = 0.5$

3. **Ans (A)**



From the figure, it is clear that the distance covered by the plank is ℓ , when cylinder has moved through distance $\ell/2$.

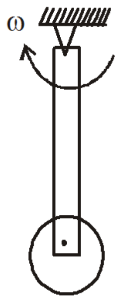
4. **Ans (A)**



PART-1 : PHYSICS

SECTION-I (ii)

5. **Ans (A,C)**



$$mg\frac{\ell}{2} + mg\ell = \frac{1}{2}\left(\frac{m\ell^2}{3} + m\ell^2\right)\omega^2$$

$$\frac{3}{2}mg\ell = \frac{2ml^2}{3}\omega^2$$

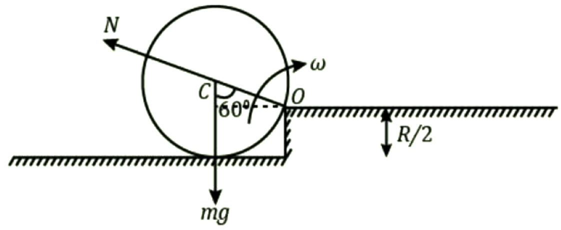
$$\omega = \frac{3}{2}\sqrt{\frac{g}{\ell}}$$

Angular acceleration of disc at horizontal initial position is zero and it is zero at all time since it can't rotate it is performing translational motion only.

6. **Ans (A,D)**

Total energy of particle is conserved so kinetic energy increases when potential energy decreases.

7. **Ans (A,B,C)**



Angular momentum about IAOR remains conserved. [no net external torque]

After hitting the step, point O behaves as the instantaneous axis of rotation. Let w; be the initial angular velocity about centre and ω_i be the angular velocity about point O immediately after collision.

Then, Li = Lf

$$\Rightarrow I_c\omega_i + mv_i r_\perp = I_o W$$

$$\Rightarrow \omega \frac{I_c\omega_i + mv_i r_\perp}{I_o}$$

$$\Rightarrow \omega \frac{mR^2\left(\frac{V}{R}\right) + mv\left(\frac{R}{2}\right)}{2mR^2}$$

$$\Rightarrow \omega = \frac{3v}{4R} \ldots.(1)$$

Now, just after impact

$$mg\cos 60^o - N = \frac{mv_c^2}{R}[\text{from FBD}]$$

$$\Rightarrow N = \frac{mg}{2} - \frac{m(R\omega)^2}{R} \ldots\ldots.(2) \quad [\because v_c = R\omega]$$

Using (1) in (2).

$$N = \frac{mg}{2} - \frac{9mv^2}{16R}$$

As the wheel ascends, q (which was initially 60^o) decreases and V_c decreases [from conservation of mechanical energy]

$$N = mg\cos\theta - \frac{mv_c^2}{R}$$

⇒ Thus, N increases.

8. **Ans (A,D)**

Initial phase of particle is zero.

PART-1 : PHYSICS

SECTION-II

1. **Ans (5.00)**
Sliding happen when friction on both blocks reach limiting value.

2. **Ans (2.00)**
Relative speed between B and C
= 2 × relative speed between A and B
= 2 × (6 − 2) = 8 m/s
$v_C = \sqrt{6^2 + 8^2} = \sqrt{10^2} = \sqrt{25 \times 4} = 2\sqrt{25}$
P = 2

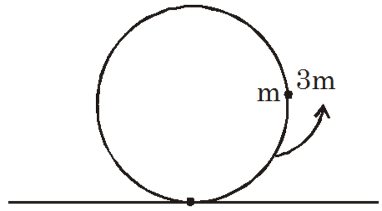
3. **Ans (6.00)**
$r = \frac{2.4\sqrt{3}}{2}$
$T_2 \cos 30° + T_1 \cos 30° + mg \cos 30° = \frac{mv^2}{r}$
$T_2 \sin 30° + mg \sin 30° = T_1 \sin 30°$
For just slack condition $T_2 = 0$
$T_1 = mg$
v = 6m/s

4. **Ans (10.00)**
After t = 4s, velocity of B becomes lesser than velocity of A and distance between the particles start decreasing. Separation is maximum at t = 4s.
$d_{max} = (X_A \text{ at } t = 4) - (X_B \text{ at } t = 4)$
$= \frac{1}{2} \times 4 \times 10 - \frac{1}{2} \times 2 \times 10 = 10m$

5. **Ans (2.00)**
$T = 2\pi\sqrt{\frac{I}{C}} \Rightarrow \frac{T'}{T} = \sqrt{\frac{I'}{I}} = \sqrt{\frac{\left(\pi\frac{4r^2}{2}\frac{t}{4}\right)4r^2}{\frac{(\rho\pi r^2 t)r^2}{2}}}$
T' = 2T

6. **Ans (2.00)**
$2\sqrt{2g\ell \sin\theta} = \sqrt{2g\ell}$
$4 \sin\theta = 1$
$8 \sin\theta = 2$

7. **Ans (8.00)**



$-NR + T(R) = (3mR^2 + 3mR^2)\alpha$
$-NR + TR = 6\ mR^2\alpha \quad N = ma$
$mg - T = m\alpha R \qquad N = m\alpha R$
$mg = m\alpha R + T$
$mg = m\alpha R + 6mR\alpha + m\alpha R$
$mg = 8m\alpha r$
$\alpha = \frac{g}{8R}$

8. **Ans (1.00)**
$v_i = mg\frac{\ell}{2}\sin 30° = mg\frac{\ell}{4}$
$v_f = \frac{m}{2}g\frac{\ell}{4}\sin 30° - \frac{m}{2}g\frac{\ell}{4} = -\frac{mg\ell}{16}$
$\Delta v = -\frac{mg\ell}{16} - \frac{mg\ell}{4} = -\frac{5mg\ell}{16}$
$\frac{5mg\ell}{16} = \frac{1}{2}mv^2$
$v^2 = \frac{5mg\ell}{16} = \frac{5}{8} \times 10 \times \frac{4}{25} = 1$

PART-2 : CHEMISTRY

SECTION-I (i)

1. **Ans (B)**
The correct answer option is (B)

2. **Ans (D)**
The correct answer option is (D)

3. **Ans (C)**
in air, $P_{N_2} = 0.8$ atm, $P_{O_2} = 0.2$ atm
$P = K_H X$ (Henry's law)
$0.8 = 2 \times 10^4 X_{N_2}$ ....(1)
$0.2 = 10^4 X_{O_2}$ ....(2)
Ratio of solubility of N_2 & O_2 is 2 : 1

4. **Ans (A)**
The correct answer is option (A)

PART-2 : CHEMISTRY

SECTION-I (ii)

5. **Ans (B,C,D)**
The correct answer option is (B), (C), (D)

6. **Ans (A,B,D)**

$r = K(B_2)(A)$

using first equation

$K_{eq} = \frac{(A)^2}{(A_2)}$

$\therefore (A) = K_{eq}^{1/2} \cdot (A_2)^{1/2}$

$\Rightarrow r = K(K_{eq})^{1/2}(B_2)(A_2)^{1/2}$

$= K'(A_2)^{1/2}(B_2)^1$

7. **Ans (A,B,D)**
The correct answer is option (A), (B), (D)

8. **Ans (A,B,C,D)**

BH_4^- and NH_4^+ – sp^3 (tetrahedral)

CO_2 and NO_2^+ – sp (linear)

BO_3^{-3}, CO_3^{-2} – sp^2 (Planar triangular)

SO_3^{-2}, ClO_3^- – sp^3 (Pyramidal)

PART-2 : CHEMISTRY

SECTION-II

1. **Ans (4.00)**
The correct answer is 4.00

2. **Ans (5.00)**
(ii), (iii), (v), (vi), (vii)

3. **Ans (2.00)**

For (A), rate = $K_A[A]$

$(t_{1/2})_A = \frac{0.693}{k_A}$

For (B), rate = $k_A[B]^2$

$(t_{1/2})_B = \frac{1}{a.k_B}$ where a is the conc. of B at the start of reaction Since half-lives are same

$\therefore \frac{0.693}{k_A} = \frac{1}{a.k_B}$

$\frac{k_A}{k_B} = 0.693a$

Since initial concentration of (A) is n times that of (B).

$\therefore [A] = na$

$\frac{r_A}{r_B} = \frac{k_A \times na}{k_b \times a^2} = 1.386$

$0.693a \times \frac{n}{a} = 1.386$

n = 2.00

4. **Ans (4.00)**

$\Delta T_f = i\,K_f m$

$0.3 = i \times 1.8 \times \frac{1.12}{268.8} \times \frac{1000}{100}$

The van't Hoff factor (i) of 4.00 indicates that each mole of $(CoCl_3 \bullet 6NH_3)$ dissociates into 4 moles of particles in the solution. This means that $(Co(NH_3)_6)Cl_3$ disassociates into one $(Co(NH_3)_6)^{3+}$ ion and three Cl- ions.

5. **Ans (8.00)**

Molarity = $\frac{3.2 \times 1.25 \times 10}{40} = 1M$

V ml stock solution taken

$M_1V_1 = M_2V_2$

$1 \times V = 20 \times 0.4$

V = 8 mL

6. **Ans (7.00)**
The correct answer is 7.00

7. **Ans (4.00)**
The correct answer is 4.00

8. **Ans (5.00)**
The correct answer is 5.00

PART-3 : MATHEMATICS

SECTION-I (i)

1. **Ans (C)**

$\alpha + \beta = (2a+1)$; $\quad \gamma + \delta = 4 - a$

$\alpha\beta = a$; $\quad \gamma\delta = a - 1$

Now $\dfrac{\alpha\beta - \gamma\delta}{\beta\gamma} = \dfrac{\alpha\delta[(\alpha+\beta)-(\gamma+\delta)]}{a}$

$a - (a-1) = \dfrac{a(a-1)[(2a+1)-(4-a)]}{a}$

$a = a(a-1)(3a-3)$

$\therefore \ (a-1)^2 = \dfrac{1}{3} \Rightarrow (a-1)^{-2} = 3$

2. **Ans (B)**

$f(1) = 2$ and $f(x+y) = f(x) + f(y) \Rightarrow f(x) = 2x$

$$\sum_{r=1}^{10} (2r)^2 = 4\left[\frac{10.11.21}{6}\right] = 1540$$

3. **Ans (B)**

$\dfrac{2x+3}{4x^2+x-3} > 0$ and $-1 \leqslant \dfrac{2x-1}{x+2} \leqslant 1$

$\dfrac{2x+3}{(4x-3)(x+1)} > 0 \quad \dfrac{3x+1}{x+2} \geqslant 0 \ \& \ \dfrac{x-3}{x+2} \leqslant 0$

– + – +

$-3/2 \quad -1 \quad 3/4$

$(-\infty, -2) \cup \left[\dfrac{-1}{3}, \infty\right)$ ……..(1)

$(-2, 3]$ ……..(2)

$\left[\dfrac{-1}{3}, 3\right]$ ……..(3)

$(1) \cap (2) \cap (3)$

$\left(\dfrac{3}{4}, 3\right]$

$\alpha = \dfrac{3}{4} \quad \beta = 3$

$5\beta - 4\alpha = 15 - 3 = 12$

4. **Ans (D)**

$$\lim_{x\to 0}\left(\left[\frac{x}{\tan x}\right] + \left[\frac{2x}{\tan 2x}\right] + \ldots\ldots + \left[\frac{2015x}{\tan 2015x}\right]\right) = 0$$

PART-3 : MATHEMATICS

SECTION-I (ii)

5. **Ans (A,B,C,D)**

$T_r = \dfrac{1}{r(r+1)} = \dfrac{1}{r} - \dfrac{1}{r+1}$

$\displaystyle\sum_{r=1}^{i} T_r = 1 - \frac{1}{i+1} = \frac{i}{i+1}$

$\displaystyle\prod_{i=1}^{n} \frac{i}{i+1} = \frac{1}{2}.\frac{2}{3}.\frac{3}{4}\ldots\frac{n}{n+1} = \frac{1}{n+1}$

$\displaystyle\sum_{n=1}^{k}\left(\frac{1}{n}\left(\prod_{i=1}^{n}\left(\sum_{r=1}^{i} T_r\right)\right)\right) = \sum_{n=1}^{k}\frac{1}{n(n+1)}$

$= \dfrac{100}{101}$

$\therefore q - p = 1$

6. **Ans (A,B,D)**

$p(p(x)) = a(ax+d) + d$

$= a^2x + ad + d = bx + c$

$\Rightarrow a^2 = b \quad ...(1) \quad$ and $\quad ad + d = c \quad ...(2)$

Let G.P. be a, ar, ar^2, ar^3

$b = ar, \ c = ar^2, \ d = ar^3$

from (1) and (2)

$a^2 = ar \Rightarrow \boxed{a = r}$

and $ar^3(a+1) = ar^2 \Rightarrow r(a+1) = 1$

$\Rightarrow r(r+1) = 1$

$\Rightarrow r^2 + r - 1 = 0$

$\Rightarrow r = \dfrac{-1+\sqrt{5}}{2} = a$ or $\dfrac{-1-\sqrt{5}}{2}$ (rejected)

$$S\infty = \frac{\frac{\sqrt{5}-1}{2}}{1-\left(\frac{\sqrt{5}-1}{2}\right)} = \frac{\sqrt{5}-1}{3-\sqrt{5}} = \frac{\sqrt{5}+1}{2}$$

7. **Ans (A,D)**

$$\tan^{-1}\left(\frac{2x-1}{10}\right)+\tan^{-1}\left(\frac{1}{2x}\right)=\frac{\pi}{4}$$

$$\Rightarrow \tan\left(\tan^{-1}\left(\frac{2x-1}{10}\right)+\tan^{-1}\left(\frac{1}{2x}\right)\right)=\tan\frac{\pi}{4}$$

$$\Rightarrow \frac{\frac{2x-1}{10}+\frac{1}{2x}}{1-\left(\frac{2x-1}{10}\right)\left(\frac{1}{2x}\right)}=1$$

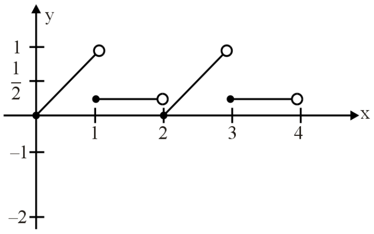
$$\Rightarrow \frac{4x^2-2x+10}{20x-2x+1}=1$$

$$\Rightarrow 4x^2-20x+9=0$$

$$\Rightarrow (2x-1)(2x-9)=0$$

$$\Rightarrow x=\frac{1}{2} \text{ or } x=\frac{9}{2}$$

8. **Ans (A,D)**



$$f(x)=\begin{cases} x & , \quad 0\leqslant x<1 \\ \frac{1}{2} & , \quad 1\leqslant x<2 \\ x-2 & , \quad 2\leqslant x<3 \\ \frac{1}{2} & , \quad 3\leqslant x<4 \end{cases}$$

PART-3 : MATHEMATICS

SECTION-II

1. **Ans (0.28)**

$$\frac{1}{\alpha}+\frac{2}{\alpha^2}+\frac{3}{\alpha^3}+\ldots\infty=\frac{1/\alpha}{\left(1-\frac{1}{\alpha}\right)^2}=\frac{\alpha}{(\alpha-1)^2}$$

$$\Rightarrow \sum_{n=1}^{\infty}S_n=\frac{\alpha}{(1-\alpha)^2}+\frac{\beta}{(1-\beta)^2}$$

also $\alpha^2-2\alpha-6=0 \Rightarrow (\alpha-1)^2=7$ & $(\beta-1)^2=7$

$$\Rightarrow \sum_{n=1}^{\infty}S_n=\frac{\alpha}{7}+\frac{\beta}{7}=\frac{\alpha+\beta}{7}=\frac{2}{7}$$

2. **Ans (3.00)**

$f(x+y)=f(x)f(y)$

$f(2)=(f(1))^2$, $f(3)=(f(1))^3$ and so on

$$\sum_{r=1}^{n}f(a+r)=f(a)f(1)(1+f(1)+(f(1))^2+\ldots+(f(1))^{n-1})$$

$$=f(a)f(1)\left(\frac{(f(1))^n-1}{(f(1))-1}\right)$$

$$=f(a)\frac{3.(3^n-1)}{2}$$

$$=\frac{3^{a+1}(3^n-1)}{2}$$

$$\Rightarrow 2\sum_{r=1}^{n}f(a+r)=81(3^n-1)$$

$$\Rightarrow 3^{a+1}=81 \Rightarrow a=3$$

3. **Ans (2016.00)**

Putting x = 2, we get

$f(2)+2f(1009)=6$ ...(i)

Putting, x = 1009, we get

$f(1009)+2f(2)=3027$ ...(ii)

solving for f(2), we get f(2) = 2016

4. **Ans (1062.00)**

$S=\{-19,-18,\ldots\ldots..0,1,2\ldots\ldots20\}$

$$\sum_{n\in s}f(n)=2\left[2\sum_{n=1}^{19}n^2\right]+800-60$$

$$=9880+800-60$$

$$=10620$$

5. **Ans (7.00)**

$$S_n=\sum_{n=1}^{\infty}\tan^{-1}\left(\frac{1}{1+(n^2-3n+2)}\right)$$

$$S_n=\sum_{n=1}^{n}\left(\tan^{-1}(n-1)-\tan^{-1}(n-2)\right)$$

$$S_n=\tan^{-1}(n-1)+\tan^{-1}1$$

$$S_\infty=\frac{\pi}{2}+\frac{\pi}{4}=\frac{3\pi}{4}$$

6. **Ans (0.75)**

$$\lim_{x\to 0} \frac{a + \left(x - \frac{x^2}{2}\right) + bx}{x^2} = \ell$$

$$\lim_{x\to 0} \frac{a + (b+1)\,x - \frac{x^2}{2}}{x^2} = \ell$$

If limit exist then, $a = 0,\ b = -1,\ \ell = -\frac{1}{2}$

7. **Ans (7.07)**

Apply L'Hopital

$$\lim_{x\to \frac{\pi}{4}} \frac{0 - 5(\cos x + \sin x)^4 (\cos x - \sin x)}{-2\cos 2x}$$

$$\lim_{x\to \frac{\pi}{4}} \frac{5}{2}(\cos x + \sin x)^3$$

$= 5\sqrt{2}$

$= 7.07$

8. **Ans (7.00)**

$f(1^{-1}) = f(1) = f(1^+)$

$\Rightarrow 6a - b - 10c = 3 \quad ....(1)$

$f(2^-) = f(2) = f(2^+)$

$\Rightarrow 5a + 7b + 5c = 37 \quad ....(2)$

Solving (1) & (2)

$\Rightarrow 16a + 13b = 77$ only at $a = 4,\ b = 1,\ c = 2$

$\Rightarrow a + b + c = 7$