FIITJEE MONTHLY ASSESSMENT TEST

PHYSICS, CHEMISTRY & MATHEMATICS

CM Test-2

Batch: CM-1820 QP CODE: 114030

ANSWER KEY

SECTION-I PHYSICS Part-A		C.CODE	SECTION-II CHEMISTRY Part-A		C.CODE	SECTION-III MATHEMATICS Part-A		C.CODE
1.	D	**P110708, P110715, P110718**	**1.**	B	**C111909**	**1.**	A	**M110115**
2.	A	**P110715, P110718**	**2.**	B	**C110503**	**2.**	A	**M111007 M111008**
3.	A	**P110805**	**3.**	A	**C111901**	**3.**	B	**M110105**
4.	C	**P110806**	**4.**	C	**C110503**	**4.**	A	**M111001**
5.	B	**P110807**	**5.**	B	**C111901**	**5.**	B	**M111002**
6.	A	**P110807, P110607 P110609**	**6.**	B	**C110502**	**6.**	A	**M110116**
7.	B	**P110701 P110716**	**7.**	B	**C111904**	**7.**	D	**M110115**
8.	C	**P110801**	**8.**	C	**C110501**	**8.**	D	**M111013**
9.	ABCD	**P110721 P111825**	**9.**	ACD	**C111901 C111906**	**9.**	ABC	**M111002**
10.	AC	**P110723 P111831**	**10.**	ABCD	**C110504**	**10.**	AD	**M110116**
11.	AB	**P110714 P110715**	**11.**	BC	**C110502**	**11.**	CD	**M111005**
12.	BC	**P110807**	**12.**	ACD	**C110507**	**12.**	AD	**M110104**
Part-B			**Part-B**			**Part-B**		
1.	(A)-T (B)-T (C)-P (D) P	**P110810**	**1.**	(A)-Q (B)-PS (C)-PS (D)-S	**C123203 C123204**	**1.**	(A) - R,S; (B) – P,Q,R,S; (C) - R,S; (D) - R,S	**M111022**
2.	(A)-PQRST (B)- PQRST (C)-PQST (D)- PQRST	**P110811 P110723 P110807 P111830**	**2.**	(A)-R,T (B)-Q,S (C)-P,T (D)-R,T	**C110502 C110503**	**2.**	(A) - R; (B) - P; (C) - Q; (D) - S	**M110118**
Part-C			**Part-C**			**Part-C**		
1.	4	**P110712**	**1.**	5	**C111902**	**1.**	6	**M122128**
2.	5	**P110802**	**2.**	8	**C110504**	**2.**	8	**M122128**
3.	2	**P110708**	**3.**	1	**C110504**	**3.**	9	**M112403**
4.	6	**P110717**	**4.**	4	**C110503**	**4.**	4	**M110118**
5.	4	**P110804 P111803**	**5.**	4	**C111908**	**5.**	7	**M110118**
6.	6	**P110717**	**6.**	9	**C110501**	**6.**	0	**M110110**

HINTS AND SOLUTION

PHYSICS

PART – A

8. **C**

$v_0 = 4\sqrt{gR}$

$\vec{J} = \Delta\vec{P}$

$-\int T dt = 2M\left(v - 4\sqrt{gR}\right)$

$-\int T dt = 2M\left(R\omega - 4\sqrt{gR}\right)$ ...(i)

$\left(\int T dt\right)R = MR^2\omega$ ...(ii)

From (i) and (ii)

$\omega = \frac{8}{3}\sqrt{\frac{g}{R}}$ and $v = \frac{8}{3}\sqrt{gR}$

11. **AB**

$20 - T_1 = 2a$ (for 2 kg block) ....(i)

$T_2 - 10 = 1a$ (for 1 kg block) ....(ii)

$T_1\frac{1}{2} - T_2\frac{1}{2} = (2)\left(\frac{1}{2}\right)^2\frac{1}{2}(2)\frac{a}{1/2}$ (for the shaft + disc system)

So, $T_1 - T_2 = 2a$ ....(iii)

After solving these three equation

$a = 2\ m/s^2$

12. **BC**

$v_{CM} = \omega\sqrt{R^2 - \frac{3R^2}{4}} = \omega\frac{R}{2}$ (from pure rolling)

$mgh = \frac{1}{2}mv_{cm}^2 + \frac{1}{2}\frac{2}{5}mR^2\omega^2$ (from conservation of energy)

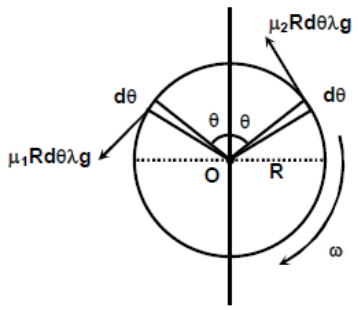
$\therefore\ v_{CM} = \sqrt{\frac{10gh}{13}}$

PART – C

1. **4**

$$2\left[\int_0^{\pi/2}(\mu_1 - \mu_2)Rg\lambda\cos\theta d\theta\right] = 2(\mu_1 - \mu_2)R\lambda g$$

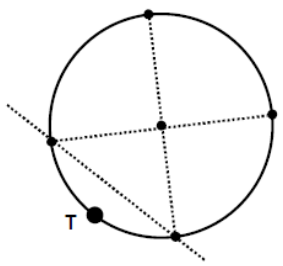
$$\therefore\ a = \frac{2(\mu_1 - \mu_2)R\lambda g}{2\pi R\lambda} = 4$$



2. **5**

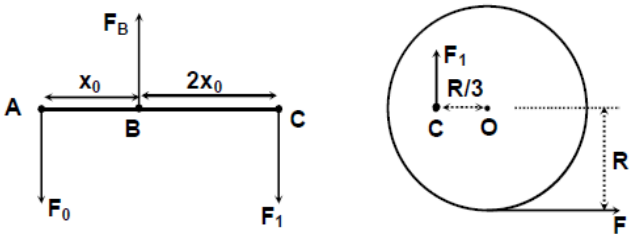
$$2g\left(R\frac{1}{\sqrt{2}}\right) \geq mg\left(R - \frac{R}{\sqrt{2}}\right)$$

$$m \leq \frac{2}{\sqrt{2} - 1} = 5\ kg$$



4. **6**

$F_1 = 3F$ and $F_0 = 2F_1 = 6F = 60$ N



5. **4**

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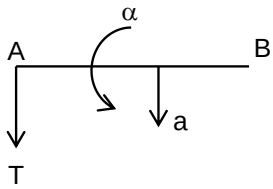

$$a = \frac{T}{m}$$

$$\alpha = \frac{Tl/2}{\frac{ml^2}{12}} = \frac{6T}{ml}$$

$$\therefore\ a_A = a + \alpha\frac{l}{2} = \frac{T}{m} + \frac{3T}{m} = \frac{4T}{m}\ ;\quad \therefore\ a_{ball} = \frac{T}{m}$$

$$\therefore\ \text{Required ratio} = \frac{4T}{m}\Big/\frac{T}{m} = 4$$

6. **6**

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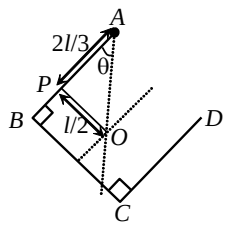
In equilibrium vertical line passes through the centre of mass of the system of three rods.

Let *O* be the centre of mass.



In triangle *AOP*, $\tan\theta = \frac{l/2}{2l/3} = \frac{3}{4}$

$$\therefore\ \sin\theta = \frac{3}{5}$$

CHEMISTRY

PART - A

2. B

NaH_2PO_4 is incomplete acid salt

$$p^H = \frac{p^{Ka_2} + p^{Ka_1}}{2}$$

$$= \frac{p^{k_2} + p^{k_1}}{2}$$

$$= \frac{2.15 + 7.20}{2} = \frac{9.35}{2} = 4.675$$

4. C

$HA + NaOH \longrightarrow H_2O + NaA$

$$k_{eq} = \frac{1}{k_h \text{ of NaA}}$$

$$= \frac{k_a}{k_w}$$

$$= \frac{10^{-4}}{10^{-14}} = 10^{10}$$

6. B
Factual

8. C
When AgCl just starts to ppt

$$\left(Ag^+\right)\left(Cl^-\right) = K_{sp}\left(AgCl\right)$$

$$\left(Ag^+\right)\left(0.05\right) = 10^{-10}$$

$$\left(Ag^+\right) = \frac{10^{-10}}{0.05} = \frac{10^{-8}}{5} = 2\times10^{-9}$$

Conc. of I^- at that time when

$$\left[Ag^+\right] = 2\times10^{-9}$$

$$\left[Ag^+\right]\left[I^-\right] = 4\times10^{-16}$$

$$2\times10^{-9}\left(I^-\right) = 4\times10^{-16}$$

$$\left[I^-\right] = 2\times10^{-7}$$

10. Factual (Buffer)
11. Factual
12. (A)(C)(D)

$$\overset{0.1\,M}{H_2A} \rightleftharpoons \overset{10^{-3}}{H^+} + \overset{10^{-3}}{HA^-} \qquad k_{a_1}$$

$$\underset{10^{-3}}{HA^-} \rightleftharpoons \underset{10^{-3}}{H^+} + \underset{10^{-12}}{A^{-2}} \qquad k_{a_2} = 10^{-12}$$

$$k_{a_1} >>> k_{a_2}$$

So, $\left(H^+\right)_{total} = \left(H^+\right)$ from 1st step

$$k_{a_1} \simeq \frac{10^{-3}\times10^{-3}}{0.1} \simeq 10^{-5}$$

$$P^{ka_2} - p^{ka_1} = 12 - 5 \simeq 7$$

PART - C

2. 8

$$\underset{0.1\,mole}{CH_3NH_2} + \underset{0.08\,mole}{HCl} \longrightarrow \underset{0}{CH_3NH_3^+Cl^-}$$

0.02 mole 0 0.08

Basic buffer apply hendersen Equation

$$P^{OH} = P^{k_b} + \log\frac{[salt]}{[base]}$$

4. 4
Nax
Salt of w.a.s.b
(Degree of hydrolysis)

$$h = \sqrt{\frac{k\omega}{k_a c}}$$

$$= \sqrt{\frac{10^{-14}}{10^{-5} \times 0.1}}$$

$$= \sqrt{10^{-8}}$$

$$= 10^{-4}$$

So, x = 4

5. 4

$$\frac{1}{2}A_2 + \frac{1}{2}B_2 \longrightarrow AB \quad \Delta n = -100\,kJ/mol$$

$$-100 = \frac{1}{2} \times \frac{1}{2} \times \frac{x}{2} - x$$

$\Rightarrow$ x = 400 kJ mol^{-1}

4 + 0 + 0 = 4

6. 9

$$k_{sp} = \left(Mg^{+2}\right)(OH)^2$$

$$10^{-11} = (0.1)\left({}^{-}OH\right)^2$$

$$10^{-10} = \left({}^{-}OH\right)^2$$

$$10^{-5} = \left({}^{-}OH\right)$$

$p^{OH} = 5$

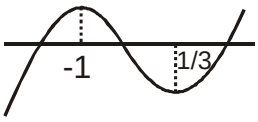
$p^{H} = 14 - 5 = 9$

MATHEMATICS

PART-A

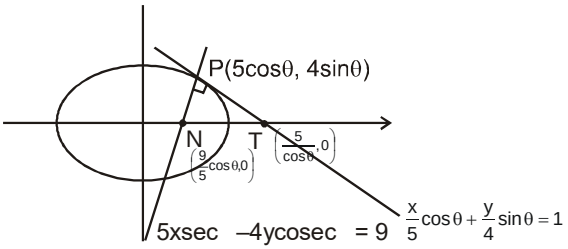
1. $f'(x) = 3x^2 + 2x - 1 = (x + 1)(3x - 1)$

$\Rightarrow$ $f(-1) > 0$ and $f\left(\frac{1}{3}\right) < 0$



$\Rightarrow$ $-1 < \lambda < \frac{5}{27}$

2.



5xsec –4ycosec = 9

$$\frac{\text{Area of } \Delta PTN}{\text{Area of } \Delta PSS'} = \frac{91}{60} \quad \frac{\Delta PTN \text{ dk {ks-}}}{\Delta PSS' \text{ dk {ks-}}} = \frac{91}{60}$$

$$\Rightarrow \frac{\frac{1}{2}.\left(\frac{5}{\cos\theta} - \frac{9}{5}\cos\theta\right).4\sin\theta}{\frac{1}{2}.6.4\sin\theta} = \frac{91}{60}$$

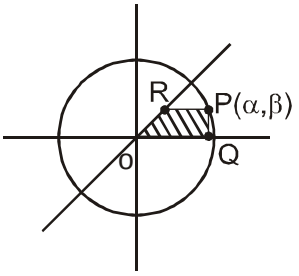
3. $f(p) = -f(q)$ $\Rightarrow$ either $f(p)\,f(q) < 0$ or $f(p) = 0 = f(q)$

$\Rightarrow$ exactly one root in (p, q) or roots are p and q

4. Let $(\alpha, \beta) = (\sqrt{3}\cos\theta, 2\sin\theta)$

$\therefore$ $R(2\sin\theta, 2\sin\theta)$

$Q(\sqrt{3}\cos\theta, 0)$



$\therefore$ Area trapezium PROQ = $\frac{1}{2}$(PR + OQ) × (PQ) = $2\cos(2\theta - \pi/3) - 1$

$\therefore$ PROQ = $\frac{1}{2}$(PR + OQ) × (PQ) = $\cos(2\theta - \pi/3) - 1/2$

$\Rightarrow$ maximum area = $2\theta = \pi/3$ $\Rightarrow$ $\theta = \pi/6$

5. $a = \cos\alpha$ & $b = \sin\alpha$ $(b > a)$

$x = \pm \frac{a^2}{b}$ & $y = \pm be$

6. $f(x) = (a^2x^2 + bx + c) - (-p^2x^2 + qx + r)$
$f(\alpha) = 0 - (-ve) = +ve$
$f(\alpha + 5) = (-ve) - (0) = -ve \quad \Rightarrow \quad$ root in $(\alpha, \alpha + 5)$

7. $\sum\left(\frac{\alpha}{\beta}+\frac{\beta}{\alpha}\right) = \frac{\alpha}{\beta}+\frac{\beta}{\alpha}+\frac{\beta}{\gamma}+\frac{\gamma}{\beta}+\frac{\gamma}{\alpha}+\frac{\alpha}{\gamma} = \frac{1}{\alpha}+\frac{1}{\beta}+\frac{1}{\gamma} - 3 = \frac{\alpha\beta+\beta\gamma+\gamma\alpha}{\alpha\beta\gamma} - 3 = \frac{a^4+4a^2+1}{a^2} - 3$

$= a^2 + \frac{1}{a^2} + 1 \quad \Rightarrow \quad$ minimum value is 3

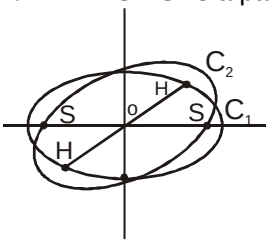
8. $\therefore$ No point of intersection of ellipse with the circle with S_1S_2 as diameter

$\Rightarrow \quad \frac{x^2}{a^2}+\frac{y^2}{b^2} = 1$ and $x^2 + y^2 = a^2 - b^2$

$\therefore \quad a^2 - b^2 < b^2 \quad \Rightarrow \quad 2b^2 > a^2$

$\Rightarrow \quad \frac{b^2}{a^2} > \frac{1}{2}$ is $e < \frac{1}{\sqrt{2}}$

9. HH′ & SS′ have same mid-point
$\Rightarrow$ HSH′S′ is a parallelogram



let one ellipse be $\frac{x^2}{a^2}+\frac{y^2}{b^2} = 1$ ...(i)
$\therefore$ H lies on it
also $H \equiv (ae_2 \cos\theta, ae_2 \sin\theta)$
putting in equation (i)
$\cos^2\theta = \frac{1}{e_1^2}+\frac{1}{e_2^2} = \frac{1}{e_1^2e_2^2}$
$\therefore$ (A), (B) & (C) are correct. (C) follows from (B)

11. Tangent at $\left(4\cos\theta, \frac{16}{\sqrt{11}}\sin\theta\right)$ is $16x\,(4\cos\theta) + 11y\left(, \frac{16}{\sqrt{11}}\sin\theta\right) = 256$ It touches $(x - 1)^2 + y^2 = 16$

$\left(4\cos\theta, \frac{16}{\sqrt{11}}\sin\theta\right) 16x\,(4\cos\theta) + 11y\left(, \frac{16}{\sqrt{11}}\sin\theta\right) = 256 \qquad (x - 1)^2 + y^2 = 16$

$\therefore \left|\frac{4\cos\theta - 16}{\sqrt{16\cos^2\theta + 11\sin^2\theta}}\right| = 4 \quad \Rightarrow \quad \cos\theta = 1/2 \quad \Rightarrow \quad \theta = \frac{\pi}{3}, \frac{5\pi}{3}$

PART-B

1. Equation of tangent be,
$y = mx \pm \sqrt{a^2x^2 + b^2}$
P(h, k) satisfies it
$\Rightarrow \quad m^2(h^2 - a^2) - 2kmh + (k^2 - b^2) = 0$

$\therefore \quad m_1 + m_2 = \tan\alpha + \tan\beta = \frac{2hk}{h^2 - a^2}$ and $m_1m_2 = \tan\alpha \tan\beta = \frac{k^2 - b^2}{h^2 - a^2}$

$\Rightarrow \quad \tan(\alpha + \beta) = \frac{2hk}{h^2 - k^2 - a^2 + b^2}$

(A) $\alpha + \beta = \frac{n\pi}{2}$ $\Rightarrow$ hk = 0 if n $\in$ even le (pair of straight lines

$h^2 - k^2 = a^2 - b^2$ if n $\in$ odd (hyperbola)

(B) $m_1 m_2 = \lambda$ $\Rightarrow$ $\frac{k^2 - b^2}{h^2 - a^2} = \lambda$

(1) $\lambda = 0 \Rightarrow$ pair of lines
(2) $\lambda = 1 \Rightarrow$ hyperbola
$\lambda = -1 \rightarrow$ circle
$\lambda = -2 \rightarrow$ ellipse

(C) $\tan\alpha \tan\beta = \mu$

$\frac{2hk}{h^2 - a^2} = \mu$

(1) $\mu = 0 \rightarrow hk = 0 \rightarrow$ pair of lines
(2) $\mu \neq 0 \rightarrow \mu x^2 - 2xy - \mu a^2 = 0$
$\Delta \equiv -\mu a^2 \neq 0$ & $h^2 - ab = 1 > 0$ $\Rightarrow$ hyperbola

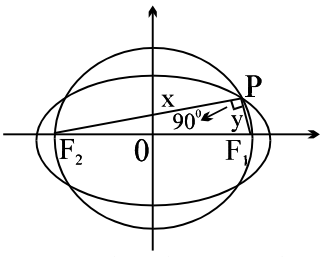
(D) $\cot\alpha + \cot\beta = c$

$\Rightarrow$ $\frac{1}{m_1} + \frac{1}{m_2} = c$ $\Rightarrow$ $c(k^2 - b^2) - 2hk = 0$

(1) $c = 0 \rightarrow$ straight line
(2) $c \neq 0 \rightarrow$ hyperbola

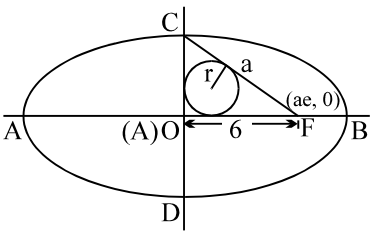
PART-C

1. x + y = 17 ; xy = 60, To find $\sqrt{x^2 + y^2}$



now, $x^2 + y^2 = (x + y)^2 - 2xy$
$= 289 - 120 = 169$
$\Rightarrow \sqrt{x^2 + y^2} = 13$

2.



$r = \frac{\Delta}{s}$ (Δ is area of triangle, s is semi-perimeter of triangle OCF)

$1 = \frac{\frac{1}{2}ae.b}{\frac{b + ae + a}{2}}$ ae = 6, $a^2e^2 = 36 = a^2 - b^2$

b + a + 6 = 6b
a + 6 = 5b
$(5b - 6)^2 - b^2 = 36$
b = 0, $\frac{5}{2}$; a = $\frac{13}{2}$

3. f (x, n) = $\sum_{k=1}^{n}\log_x\left(\frac{k}{x}\right) = \log_x\left(\frac{1}{x}\right)+\log_x\left(\frac{2}{x}\right)+.....\log_x\left(\frac{n}{x}\right) = \log_x\left(\frac{n!}{x^n}\right)$

given: f(x, 8) = f (x, 9) $\Rightarrow \log_x\left(\frac{8!}{x^8}\right) = \log_x\left(\frac{9!}{x^9}\right) \Rightarrow \frac{8!}{x^8} = \frac{9!}{x^9} \Rightarrow$ x = 9

4. Ans. 4

f(5) = –3 f(2) $\Rightarrow$ 37a + 11b + 4c = 0

f(3) = 0 $\Rightarrow$ 9a + 3b + c = 0

$\Rightarrow$ a = b, c = –12a

5. Ans. 7

$a^2 + b^2 = (\alpha + \beta)^2 + (1 - \alpha\beta)^2 = (\alpha^2 + 1)(\beta^2 + 1)$

6. Ans. 0

$\left(32+8\sqrt{15}\right)^{x^2-3} = \left(31+8\sqrt{15}\right)^{x^2-3} + 1^{x^2-3}$

$\Rightarrow$ $(a + b)^n = a^n + b^n$ $\Rightarrow$ ab = 0 or n = 1 $\Rightarrow$ $x^2 - 3 = 1$