CAREER POINT

JEE (Main & Advanced)

PTS

SAMPLE PAPER

Physics, Chemistry & Mathematics

SOLUTIONS

PTS/26/MJ-12/PCM-1 & 2

PAPER-1

PHYSICS

Q.No.	1	2	3	4	5	6	7	8	9	10
Ans.	A,B	C,D	A,C	B	A	B	6.00	0.00	3.00	1.00
Q.No.	11	12	13	14	15	16	17	18		
Ans.	7.00	5.00	8.00	1.00	C	A	C	C		

CHEMISTRY

Q.No.	19	20	21	22	23	24	25	26	27	28
Ans.	A,B,D	A,B,D	A,B,D	A,C,D	A,D	A,B,C,D	6.00	8.00	4.00	1.00
Q.No.	29	30	31	32	33	34	35	36		
Ans.	4.00	4.00	3.00	6.00	B	A	B	D		

MATHEMATICS

Q.No.	37	38	39	40	41	42	43	44	45	46
Ans.	C,D	A,D	B,D	A,C,D	A,C,D	A,B	8.00	4.00	1	1.00
Q.No.	47	48	49	50	51	52	53	54		
Ans.	3.00	2.00	9.00	3.00	A	D	C	A		

PHYSICS

Section – I

1.[A,B] $\frac{V^3}{T^2} = \text{cost}$ & $PV = nRT$

i.e. $PV^{\frac{-1}{2}} = \text{const}$

i.e. Polytrophic Process $PV^x = \text{const}$

where $x = -\frac{1}{2}$

$$W = \frac{P_2V_2 - P_1V_1}{1-x} = \frac{nR\,\Delta T}{1-x} = 200R$$

$$C = C_V + \frac{R}{1-x} = \frac{13}{6}R$$

2.[C,D] The capacitances of the two capacitors are $C_1 = 4\pi\varepsilon_0 R$ & $C_2 = 4\pi\varepsilon_0(2R)$

The initial energy, $E_i = \frac{Q^2}{2C_1}$

The final energy, $E_f = \frac{Q^2}{2C_2}$

The heat produced = $E_i - E_f$

$$= \frac{Q^2}{2}\left[\frac{1}{4\pi\varepsilon_0 R} - \frac{1}{2\times 4\pi\,\varepsilon_0 R}\right]$$

$$= k\,\frac{Q^2}{2R}\left(1-\frac{1}{2}\right) = \frac{kQ^2}{4R}$$

3.[A,C] $\log\left|\frac{dN}{dt}\right| = \log(N_0\lambda) - \lambda t$

$\therefore$ At $t = 0$, $A_0 = \log\left|\frac{dN}{dt}\right| = \log\,(N_0\lambda)$

$$\lambda = \frac{A_0 - A_0/2}{t_0} = \frac{A_0}{2t_0}$$

$$N_0 = \frac{1}{\lambda}e^{A_0}$$

$$\text{Half-life} = \frac{2t_0 \log 2}{A_0}$$

4.[B] $I_1 = \frac{R_2 I}{R_2 + R_3}$

$$= \frac{R_2}{R_2+R_3} \times \frac{E}{\left[R_1 + \frac{R_2R_3}{R_2+R_3}\right]}$$

$$= \frac{ER_2}{R_1R_2 + R_1R_3 + R_3R_2}$$

After interchanging ammeter and source of emf, new current

$$I_2 = \frac{R_2 I'}{R_1 + R_2}$$

$$= \frac{R_2}{R_1+R_2}\frac{E}{\left[R_3 + \frac{R_1R_2}{R_1+R_2}\right]}$$

$$= \frac{ER_2}{R_1R_2 + R_2R_3 + R_3R_1} = I_1$$

5.[A] Magnetic field due to 1A wire is B'
Magnetic field due to 2A wire is 2B'
so net B' + 2B'

6.[B] $\therefore$ COM frame is zero momentum frame. so two particles must move is opposite direction to get zero momentum and heavier particle must move with small velocity to get zero momentum.

Section – II

7.[6.00] Total energy of the hydrogen-like atom (atomic number Z) in the nth Bohr orbit is

$$E_n^2 = -\frac{Z^2}{n^2} \times 13.6 \text{ eV}$$

$$E_2^2 = \frac{-13.6}{4}Z^2 = -3.4\,Z^2 \text{ eV}$$

and $E_3^2 = \frac{-13.6}{9}Z^2 = -1.5\,Z^2$ eV

$\therefore\ E_3^2 - E_2^2 = -1.5\,Z^2 - (-3.4\,Z^2)$
$= -1.5\,Z^2 + 3.4\,Z^2 = 1.9\,Z^2$ eV

But $1.9\,Z^2$ eV = 68.0 eV (given)

$\therefore Z^2 = \frac{68.0}{1.9} = 36$

$\therefore Z = 6$

8.[0.00] $F = q\,v\,B \sin\theta$
B is along the central axis & velocity of q is also along central axis
$\therefore\ \theta = 0$
$\therefore\ F = 0$

9.[3.00] $E = \frac{kQ[(3-2)\hat{i} + \hat{j} + \hat{k})}{(\sqrt{3})^3} + kQ_1\left(\frac{3\hat{i} + \hat{j} + \hat{k}}{(\sqrt{11})^3}\right)$

x component as E is zero

$$Q = -3Q_1 \times \left(\frac{\sqrt{3}}{\sqrt{11}}\right)^3$$

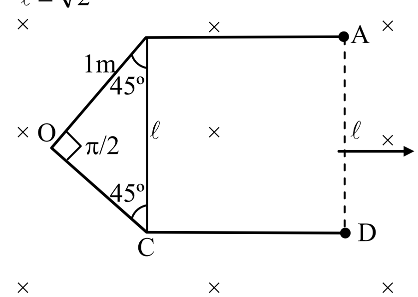
$$Q = -3 \times 11\left(\frac{11}{3}\right)^{3/2} \times \frac{(3)^{3/2}}{11}$$

value of Q = 33 nC.

10.[1.00] $v_A - v_D = v \times B \times \ell$
$= 1 \times 1 \times \sqrt{2}$; $= 1.41$ volt

sine rule $\frac{\ell}{\sin 90^\circ} = \frac{\ell}{\sin 45^\circ}$

$\ell = \sqrt{2}$



11.[7.00] $\frac{5}{3}\sin 30^\circ = n\,.\frac{5}{6} \Rightarrow n = 1$

$\sin\theta_c = \frac{3}{5} \Rightarrow \theta_c = 37^\circ$

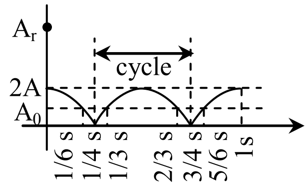
and so 37 – 30 = 7

12.[5.00] Velocity of first block before collision
$V_1^2 = 1^2 - 2(2) \times 0.16$
$= 1 - 0.64$
$V_1 = 0.6$ m/s
By conservation of momentum,
$2 \times 0.6 = 2\,V_1' + 4V_2'$
Also $V_2' - V_1' = V_1$ for elastic collision
It gives $V_2' = 0.4$ m/s
$V_1' = -0.2$ m/s
Now distance moved after collision

$s_1 = \frac{(0.4)^2}{2\times 2}$ & $s_2 = \frac{(0.2)^2}{2\times 2}$

$\therefore\ s = s_1 + s_2 = 0.05\text{m} = 5\text{cm}.$

13.[8.00]



$y_1 = A \sin \omega_1 t$

$y_2 = A \sin \omega_2 t$

$$y_r = 2A \cos \left\{\frac{(\omega_2 - \omega_1)}{2} t\right\} \left\{\sin \frac{(\omega_2 + \omega_1)}{2} t\right\}$$

Resultant amplitude $A_r = 2A_0|\cos (\Delta\omega)t/2|$

$(\Delta\omega)\frac{t}{2} = \frac{\pi}{2} \Rightarrow t = \frac{1}{4}$ s

$(\Delta\omega)\frac{t}{2} = \frac{\pi}{3} \Rightarrow t = \frac{1}{6}$ s

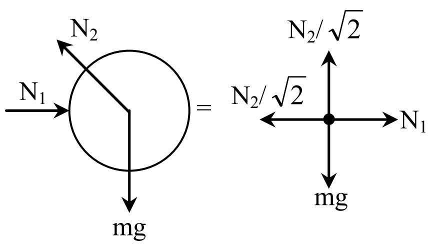
in one cycle of intensity of 1/2s, the detector remain idle for

$2\left(\frac{1}{4} - \frac{1}{6}\right)$ s $= \frac{1}{6}$ sec

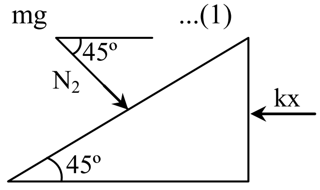
$\therefore$ In 1/2 sec cycle, active time is $\left(\frac{1}{2} - \frac{1}{6}\right) = 1/3$ sec

$\therefore$ In 12 sec interval, active time is $12 \times \frac{(1/3)}{(1/2)} = 8$ sec

14.[1.00]



$N_2 = \sqrt{2}$ mg ...(1)



$\frac{N_2}{\sqrt{2}} = kx$

$\frac{\sqrt{2}mg}{\sqrt{2}} = kx$

$x = \frac{mg}{k}$

Section – III

15.[C]

16.[A] Initial and final charges on capacitor are shown in figure a and b respectively charge flown through AB is $\frac{CE}{5}$ work done by battery

$= W_b = (Q - Q_{take})\ \varepsilon$

Heat produced $= W_b - \Delta U = \frac{C \in^2}{105}$ J

Initially $C_{eq} = \frac{50}{21}C$; $Q = \frac{50}{21}CE$

$$U = \frac{1}{2} \times \frac{50}{21} \times CE^2$$

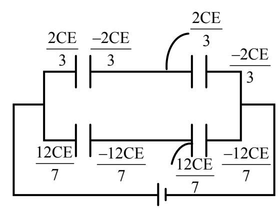


fig (a)

Finally $C'_{eq} = \frac{12}{5}C$; $Q' = \frac{12}{5}CE$

$$U' = \frac{1}{2} \times \frac{12}{5}CE^2 = \frac{6}{5}CE^2$$

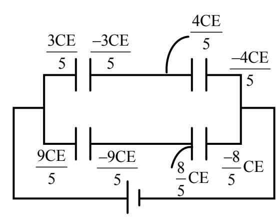


fig (b)

17.[C] $\dot{q}\left(\frac{4}{3}\pi r_0^3\right) = h\ (4\pi r_0^2)\ (T_S - T_f)$

$$(T_S - T_f) = \frac{\dot{q}r_0}{3h}$$

18.[C] $-\frac{dT}{dr} \propto r$

$$\therefore \frac{-\left.\frac{dT}{dr}\right|_{r=\frac{r_0}{2}}}{-\left.\frac{dT}{dr}\right|_{r=r_0}} = \frac{1}{2}$$

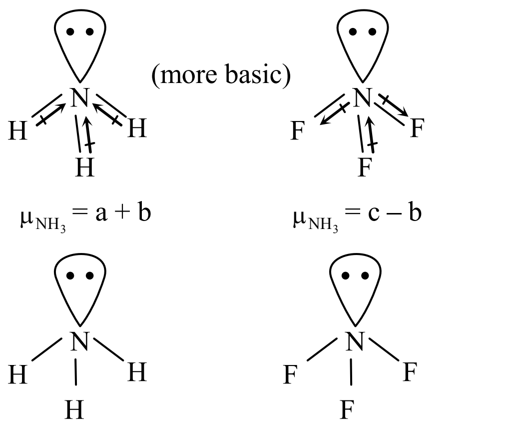
CHEMISTRY

Section – I

19.[A,B,D] R–C(=O)–$\ddot{N}H_2$ has least +ve charge density among all of the given compound.

20.[A,B,D] $IE_1 = 100$, $IE_2 = 150$

21.[A,B,D]

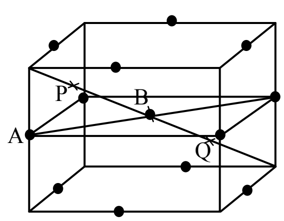


Electronegativity of terminal decreases B.A. ↓

22.[A,C,D] * Work is the form of energy between system and surrounding in adiabatic process
* Intensive property is not additive in nature
* Work done in free expansion for ideal gas is zero
* For an isolated system the entropy either increases or remain constant.

23.[A,D] (a) $BaO_2 + H_2O \longrightarrow Ba(OH)_2 + H_2O_2$
(b) $Na_2O_2 + H_2O \rightarrow NaOH + H_2O_2$

24.[A,B,C,D]

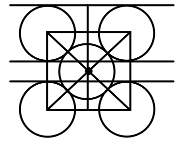


* $AB = \dfrac{\sqrt{2}a}{2}$ and in CCP ⇒ $\sqrt{2}a = 4r$

∴ $AB = 2r$

* $PQ = \dfrac{\sqrt{3}a}{2}$ and $PQ = \dfrac{\sqrt{3}}{2} \times 2\sqrt{2}\,r = \sqrt{6}r$

* $PB = \dfrac{\sqrt{3}a}{4} = \dfrac{\sqrt{3}}{4} \times 2\sqrt{2}\,r = \sqrt{\dfrac{3}{2}}\,r$

*


Distance between the surface of atoms

$= a - 2r$

$= a - \dfrac{\sqrt{2}a}{2} = a - \dfrac{a}{\sqrt{2}}$

$= a\left(\dfrac{\sqrt{2}-1}{\sqrt{2}}\right)$

We know $\sqrt{2}a = 4r$

$= \dfrac{4r}{\sqrt{2}}\,\dfrac{(\sqrt{2}-1)}{\sqrt{2}}$

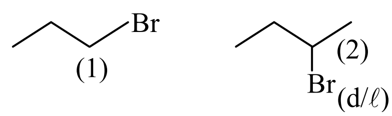
$= 2r(\sqrt{2}-1)$

Section – II

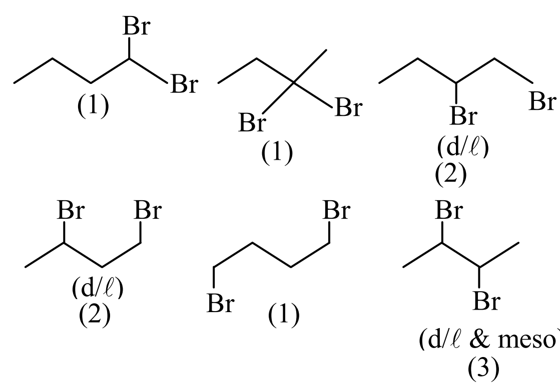
25.[6.00] A, B, C, D, F & G

show mutaroation because these molecule have –OH group on anomeric carbon.

26.[8.00] Mono brominated products are



Dominated products are



27.[4.00] $\Delta T_b = K_b \times \dfrac{W_B}{M_B} \times \dfrac{1000}{W_A}$

$(47.98 - 46.3) = 2.34 \times \dfrac{28}{M_{B\,exp.}} \times \dfrac{1000}{315}$

$M_{B\,exp.} = 123.8$

$i = \dfrac{M_{normal}}{M_{abnormal}}$ or $\dfrac{M_{theoritical}}{M_{exp.}} = 1 - \alpha + \dfrac{\alpha}{n}$

if $\alpha = 1$(degree of association)

$\frac{31}{123.8} = \frac{1}{n} \Rightarrow n = 4$ or $n = 4$

28.[1.00] $Cl_2 + Cl_2O_n \longrightarrow 2Cl_2 + \frac{n}{2} O_2$

30 ml 30 ml — —

— — 60 ml $\frac{n}{2} \times 30 = 15$ n ml

KOH will absorb Cl_2 gas

$\therefore$ 15n = 15

n = 1

29.[4.00] $\frac{1}{2} H_2(g) + \frac{1}{2} Cl_2(g) \rightarrow HCl(g), \Delta G^o = 1.72$ kJ/mol

and ΔG^o for $2HCl(g) \rightleftharpoons H_2(g) + Cl_2(g)$

is

$\Delta G^o = \Sigma \Delta G^o_{products} - \Sigma \Delta G^o_{reactant}$

$\Delta G^o = 0 - 2 \times 1.72$

$\Delta G^o = -2.303$ RT log K_p

$-3.44 \times 10^3 = -5700 \log k_p$

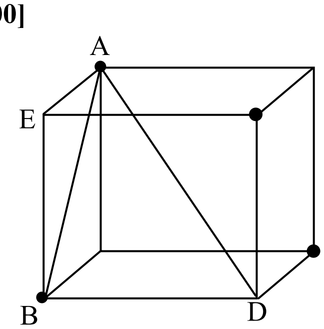
$\log k_p = 0.6$

$k_p = 4$

30.[4.00] Nylon-6 and Teflon are homo polymer rest all are co-polymer.

31.[3.00] The products those give Tollen's test are HCHO, HCOOH and CH_3–CHO

32.[6.00]



AB = 2R

BE edge length = $\frac{2R}{\sqrt{2}}$

$\therefore$ Body diagonal AD = $\sqrt{3}$ BE

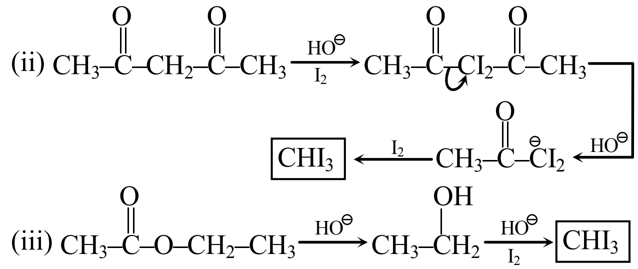
$= \sqrt{3} \times \frac{2R}{\sqrt{2}}$

$= \sqrt{6}$ R

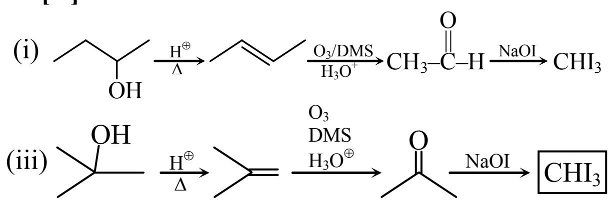
$\therefore$ x = 6

Section – III

33.[B]



34.[A]



35.[B] $X_2 = O_2, X_3 = O_3, Y_2 = I_2$

$2I^{\ominus} + H_2O + O_3 \longrightarrow 2OH^- + I_2 + O_2$

$I_2 + S_2O_3^{-2} \longrightarrow 2I^- + S_4O_6^{-2}$

I_2 + starch sol $\longrightarrow$ Blue

$I_2 + I^-$ (excess) $\longrightarrow I_3^{\ominus}$ (Brown coloured I_3^- ion)

O_3 is pale blue gas which has characteristic small

36.[D] $X_2 = O_2, X_3 = O_3, Y_2 = I_2$

$2I^{\ominus} + H_2O + O_3 \longrightarrow 2OH^- + I_2 + O_2$

$I_2 + S_2O_3^{-2} \longrightarrow 2I^- + S_4O_6^{-2}$

I_2 + starch sol $\longrightarrow$ Blue

$I_2 + I^-$ (excess) $\longrightarrow I_3^{\ominus}$ (Brown coloured I_3^- ion)

O_3 is pale blue gas which has characteristic small.

MATHEMATICS

Section – I

37.[C,D] $\frac{\sin\left(\frac{\pi}{12}\right)}{\sin x} + \frac{\cos\left(\frac{\pi}{12}\right)}{\cos x} = 2$

$\sin\left(x + \frac{\pi}{12}\right) = \sin 2x$

$x = \frac{\pi}{12}, \frac{11\pi}{36}$

38.[A,D] S is a point circle which represent point (2, –3) and this point also lies on line L.

39.[B,D] $f : (0, \infty) \rightarrow (-\infty, \infty)$ be defined as $f(x) = e^x + \ell n x$

$f'(x) = e^x + \frac{1}{x} > 0, \ x \in (0, \infty)$

$\lim_{x \to \infty} f(x) = \infty$ and $\lim_{x \to 0^+} f(x) = -\infty$

f(x) is bijective

f(1) = e, g(e) = 1

$g'(e) = \frac{1}{f'(1)}$, $f'(x) = e^x + \frac{1}{x}$, $f'(1) = e + 1$

$f''(x) = e^x - \frac{1}{x^2}$, $f''(1) = e - 1$

$g'(e) = \frac{1}{e+1}$

$g''(e) = \frac{-f''(1)}{(f(1))^3} = \frac{1-e}{(e+1)^3}$ $\left\{g''(x) = -\frac{f''(x)}{(f'(x))^3}\right\}$

40.[A,C,D] $P'(x) = 6x^2 - 6(2 + \lambda)x + 12\lambda$

$P'(x) = 0 \Rightarrow x = 2, \lambda$

For given condition $\lambda \neq 2$

41.[A,C,D] $S_n = \sum_{n=1}^{n}(2^n + n^2 + 1)$

$= \frac{2(2^n - 1)}{2-1} + \frac{n(n+1)(2n+1)}{6} + n$

$= 2^{n+1} + \frac{n^3}{3} + \frac{n^2}{2} + \frac{7n}{6} - 2$

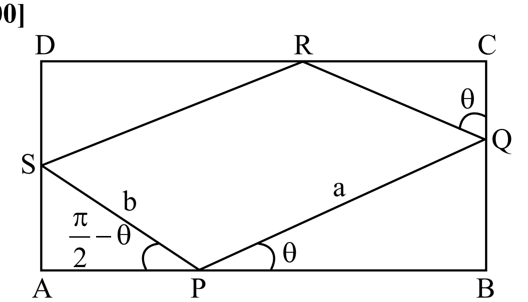
42.[A,B] Let $\cos^{-1}x = \theta \in [0, \pi]$

$\Rightarrow \cos^{-1}\sqrt{\frac{1+x}{2}} = \cos^{-1}\left(\cos\frac{\theta}{2}\right) = \frac{\theta}{2} = \frac{1}{2}\cos^{-1}x$

Also $\sin^{-1}\sqrt{\frac{1-x}{2}} = \sin^{-1}\left(\sin\frac{\theta}{2}\right) = \frac{1}{2}\cos^{-1}x$

Section – II

43.[8.00]



Here $2a + 2b = \ell$

$a + b = \frac{\ell}{2}$

Area of rectangle ABCD

= AB × BC = (AP + PB) × (BQ + QC)

= $(b \sin\theta + a\cos\theta)(a\sin\theta + b\cos\theta)$

$= ab + \left(\frac{a^2+b^2}{2}\right)\sin 2\theta$

$\therefore\ A \leq ab + \frac{a^2+b^2}{2}$

$\Rightarrow A_{max} = \frac{(a+b)^2}{2} = 32$

$\Rightarrow \frac{\ell^2}{8} = 32 \quad \Rightarrow \ell = 16$

44.[4.00] $x^2(y-3) - mx + y - n = 0,\ y \neq 3$

If $y = 3 \Rightarrow mx = 3 - n \Rightarrow x = \frac{3-n}{m}$

$m^2 - 4(y-3)(y-n) \geq 0$

$\Rightarrow 4[y^2 - (3+n)y + 3n] - m^2 \leq 0$

$\Rightarrow 4y^2 - 4y(3+n) + 12n - m^2 \leq 0$ ....(1)

Also $(y+4)(y-3) \leq 0$

$\Rightarrow y^2 + y - 12 \leq 0$ ....(2)

by comparing (1) and (2)

$4 = -4(3+n) = \frac{12n - m^2}{-12}$

$m^2 - 12n = 48,\ n = -4$

$m = 0\ \therefore\ |m + n| = 4$

45.[1.00] Let $\cot\alpha = \frac{1}{3}$ & $\cot\beta = 3$. $\forall\ \alpha + \beta = \frac{\pi}{2}$

The equation $3\cot^2\theta + 10\cot\theta + 3 = 0$

$\cot\theta = \frac{-1}{3}, -3$

$\theta = \pi - \alpha, 2\pi - \alpha, \pi - \beta, 2\pi - \beta$

Sum of angles $= 6\pi - 2(\alpha + \beta) = 6\pi - 2\left(\frac{\pi}{2}\right)$

Sum of angles $= 5\pi$

So k = 10

46.[1.00] $P(\text{Req.}) = \frac{\frac{1}{5}\times\frac{1}{2}\times\frac{2}{3}\times\frac{3}{4}}{\frac{1}{5}\times\frac{1}{2}\times\frac{2}{3}\times\frac{3}{4}+\frac{4}{5}\times\frac{1}{2}\times\frac{1}{3}\times\frac{1}{4}\times\left(\frac{1}{4}\right)^3} = \frac{96}{97}$

47.[3.00] $\because\ \alpha, \beta \in (-6, 1)$

So

(1) $f(-6) > 0 \Rightarrow P < \frac{27}{4}$ ….(i)

(2) $f(1) > 0 \Rightarrow P > 2$ ….(ii)

(3) $-12 < \alpha + \beta < 2 \Rightarrow 2 < P < 9$ ….(iii)

(4) $D \geq 0 \Rightarrow P \leq 0$ or $P \geq 6$ ....(iv)

So $P \in \left[6, \frac{27}{4}\right)$

So integral value of P = 6

$\because$ 2, g_1, g_2, g_3 …. g_{20}, 6 are in G.P.

Let common ratio is R.

So $6 = 2 \cdot R^{21} \Rightarrow R^{21} = 3$

$g_4 = 2R^4$ & $g_{17} = 2R^{17}$

So $g_4 \cdot g_{17} = 4R^{21} = 12$

48.[2.00] $\because \quad f(0) = \frac{1}{3}$

$$f'(x) = \lim_{h\to 0} \frac{f(x+h)-f(x)}{h}$$

$$= \lim_{h\to 0} \frac{f(h)+2xh(x+h)-\frac{1}{3}}{h}$$

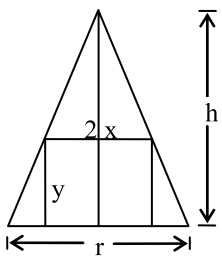
$$= 2x^2 + 2xh + \lim_{h\to 0} \frac{f(h)-\frac{1}{3}}{h}$$

$f'(x) = 2x^2 + f'(0)\ \forall\ f'(0) = \frac{4}{3}$

So $f(x) = \frac{2x^3}{3} + \frac{4x}{3} + \frac{1}{3}$

So $\int_{-3}^{3} f(x)dx = 0 + 0 + 2$

49.[9.00] Volume of cone $v_1 = \frac{1}{3}\pi r^2 h$



From figure $\frac{x}{h-y} = \frac{r}{h}$

i.e. $h - y = \frac{h}{r}x$ or $y = h(1-\frac{x}{r})$

If v be the volume of the cylinder, then

$v = \pi x^2 y = \pi x^2 h(1-\frac{x}{r}) = \pi h(x^2 - \frac{x^3}{r})$

$\frac{dv}{dx} = \pi h\, x\left(2-\frac{3x}{r}\right)$

$$\underset{}{-}\ \ \underset{0}{|}\ \ +\ \ \underset{\frac{2r}{3}}{|}\ \ -$$

Hence $x = \frac{2r}{3}$ gives a maximum of v

$\therefore\ v_2 = \pi h\left(\frac{2r}{3}\right)^2\left(1-\frac{2}{3}\right) = \frac{4}{27}.\pi r^2 h$

$\therefore\ \frac{v_1}{v_2} = \frac{1/3}{4/27} = \frac{9}{4}$ Thus $4v_1 : v_2 = 9 : 1$

50.[3.00] $\because$ The equation of line is

$$\frac{x-2}{1} = \frac{y-1}{1} = \frac{z+\frac{1}{2}}{\frac{-1}{2}}$$

Now $(\hat{i} + \hat{j} - \frac{\hat{k}}{2}).(\hat{i} + 2\hat{j} + 6\hat{k}) = 0$

So line is parallel to plane so $\perp^r$ distance of any point lie on the line is same so distance of point $(2, 1, \frac{-1}{2})$ from plane x + 2y + 6z = 10 is

$$\frac{\left|2+2-\frac{6}{2}-10\right|}{\sqrt{1+4+36}} = \frac{9}{\sqrt{41}}.$$

Section – III

51.[A]

$$F(n,p) = \frac{n^p - \binom{n}{1}(n-1)^p + \binom{n}{2}(n-2)^p ....+(-1)^{n-1}\binom{n}{n-1}1^p}{n^p}$$

… (i)

$$F(4,6) = \frac{4^6 - \binom{4}{1}3^6 + \binom{4}{2}2^6 - \binom{4}{3}1^6}{4^6} =$$

$$\frac{4096-2916+384-4}{4096} = \frac{1560}{4096} = \frac{195}{512}$$

52.[D] Also if p < n then probability is zero and if p = n by (1)

$$\frac{n^n - \binom{n}{1}(n-1)^n + ...+(-1)^{n-1}\binom{n}{n-1}1^n}{n^n} = \frac{n!}{n^n}$$

$\Rightarrow (-1)^{n-1}\ [{}^nC_1 1^n - {}^nC_2 2^n - {}^nC_3 3^n - \ldots\ldots\ldots + (-1)^{n-1}$
${}^nC_n n^n] = n!$

53.[C] $\lim_{n\to\infty} \frac{1}{n} + \frac{1}{n+1} + ... + \frac{1}{n+5n}$

$$\lim_{n\to\infty} \sum_{r=0}^{r=5n} \frac{1}{n+r} \Rightarrow \int_0^5 \frac{dx}{1+x} = \log 6$$

54.[A] $\lim_{n\to\infty} \sum_{r=1}^{r=n} \frac{n\left(1+\frac{r}{n}\right)}{n^2\left(1+\frac{r^2}{n^2}\right)}$

$$\int_0^1 \frac{1+x}{1+x^2}dx = \int_0^1 \frac{1}{1+x^2}dx + \int_0^1 \frac{x\,dx}{1+x^2}$$

$$= \left(\tan^{-1}x\right)_0^1 + \frac{1}{2}\left(\log(1+x^2)\right)_0^1$$

$$= \left(\frac{\pi}{4}-0\right) + \frac{1}{2}(\log 2 - 0)$$