FIITJEE
ALL INDIA TEST SERIES
JEE (Advanced)-2025
FULL TEST – I
PAPER –2
TEST DATE: 26-12-2024

ANSWERS, HINTS & SOLUTIONS

Physics

PART – I

SECTION – A

1. D

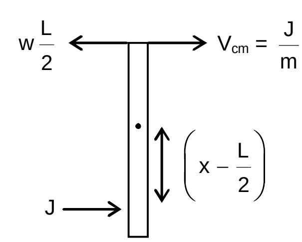
Sol. $$\frac{dQ}{dt} = \frac{K(6a^2)(T-T_0)}{x} = n\left(\frac{R}{\gamma-1}\right)\frac{dT}{dt}$$

$$\int_{T_1}^{T} \frac{dT}{T-T_0} = \frac{6Ka^2(\gamma-1)}{nRx}\int_0^t dt$$

$$T = T_0 + (T_1 - T_0)e^{\frac{6Ka^2(\gamma-1)t}{nRx}}$$

2. C

Sol. $$J\left(x-\frac{L}{2}\right) = I\omega$$

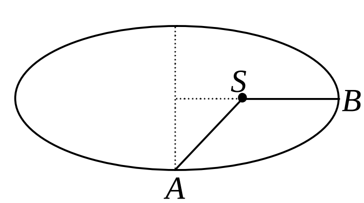


$$\omega\frac{L}{2} = V_{cm} = \frac{J}{M} \quad ; \quad \frac{J\left(x-\frac{L}{2}\right)\frac{L}{2}}{I} = \frac{J}{M}$$

$$I = \frac{ML^2}{12}$$

3. A

Sol. $$t_{AB} = \left(\frac{\text{Area} \quad SAB}{\text{Area} \quad \text{of} \quad \text{ellipse}}\right)\times T$$



$$= \frac{\left\{\frac{\pi ab}{4} - \frac{1}{2}(b)\ (ea)\right\}}{\pi ab}\times T = \left(\frac{1}{4}-\frac{e}{2\pi}\right)T$$

4. C

Sol. $$F = \frac{k}{v}$$

$m\dfrac{dv}{dt}=\dfrac{k}{v}$; $\int v\,dv=\dfrac{k}{m}\int dt$

$\dfrac{mv^2}{2}$ = kt

Work done by force = change in kinetic energy.

5. BD

Sol. Length $\propto G^x c^y h^z$

$L=\left[M^{-1}L^3T^{-2}\right]^x\left[LT^{-1}\right]^y\left[ML^2T^{-1}\right]^z$

By comparing the power of M, L and T in both sides we get

$-x+z=0, 3x+y+2z=1$ and $-2x-y-z=0$

By solving above three equations we get

$x=\dfrac{1}{2}, y=-\dfrac{3}{2}, z=\dfrac{1}{2}$

6. C

Sol. Potential of centre of sphere = $\dfrac{Kq}{r}+V_i=\dfrac{Kq}{r}$

where V_i = potential due to induced charge at centre = 0 [$\therefore$ Σq_i = 0 and all induced charges are equidistance from centre]

$\therefore$ potential at point P = $\dfrac{Kq}{r}=\dfrac{Kq}{r_1}+V_i$ (For conductor all points are equipotential)

$\therefore$ $V_i=K\left(\dfrac{q}{r}-\dfrac{q}{r_1}\right)$

7. ABD

Sol. For ammeter,

$i=\dfrac{i_{max}(R_s+R_A)}{(R_s)}$

$\Rightarrow$ $i=0.1\text{mA}$ for $R_s=50\Omega$ [as $R_A=50\Omega$ and $i_{max}=50\mu A$]

For voltmeter,

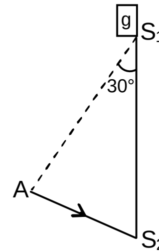
$V=i_{max}(R_A+R_V)$

$\Rightarrow$ $V\approx 10V$ for $R_v=200k\Omega$

SECTION – B

8. 8

Sol. Extra phase change in glass = phae change in water of length AS_2.



$\dfrac{2\pi t}{\lambda g}-\dfrac{2\pi}{\lambda\omega}t=\dfrac{2\pi}{\lambda\omega}\cdot\dfrac{2}{3}\sin 30^o$

$\Rightarrow$ $t\left[\dfrac{3}{2}-\dfrac{4}{3}\right]=\dfrac{4}{3}\times\dfrac{1}{3}$

$\Rightarrow$ t = $\dfrac{8}{3}$mm.

9. 6
Sol. Apply KVL.

10. 2
Sol. Applying Snell's law between the points *O* and *P*, we have

$$2\times\sin 60^0=\left(\sin 90^0\right)\times\frac{2}{\left(1+H^2\right)},\quad 2\times\frac{\sqrt{3}}{2}=1\times\frac{2}{\left(1+H^2\right)}$$

$$\left(1+H^2\right)=\frac{2}{\sqrt{3}},\qquad H=\sqrt{\left(\frac{2}{\sqrt{3}}-1\right)}$$

11. 3
Sol.
$$e=\frac{v_2-v_1}{u_1-u_2}$$
$$1=\frac{v_2-(-2)}{u_1}$$
$$u_1=v_2+2$$
$$u_1=1(-2)+5(u_1-2)$$
$$u_1=-2+5u_1-10$$
$$u_1=\frac{12}{4}=3m/s$$
$$v_2=1\,m/s$$

Kinetic energy of the centre of mass = $\frac{1}{2}\times(1+5)\times\left(\frac{3}{1+5}\right)^2=\frac{3}{4}J$

12. 5
Sol. $2g - T = 2a$ …(i)
$TR = I\alpha$ …(ii)
$a = R\alpha$ …(iii)
From (ii) and (iii) $T=\frac{Ia}{R^2}$

$$\therefore\quad 2g = a\left(2+\frac{I}{R^2}\right)$$

$$\Rightarrow\quad a=\frac{2g}{\left(2+\frac{I}{R^2}\right)}=\frac{2\times10}{2+\frac{0.2}{0.01}}=\frac{10}{11}\ m/s^2$$

13. 7
Sol.
$$P_{in}=\frac{4S}{R}+\frac{4S}{2R}=\frac{6S}{R}$$
$$P_{mid}=\frac{4S}{2R}=\frac{2S}{R}$$
as T = constant

$$\frac{P_{in}}{P_{mid}}\frac{V_{in}}{V_{mid}} = \frac{\mu_{in}}{\mu_{mid}} = \frac{3}{7} = y$$

and $\frac{P_{in}}{P_{mid}} = \frac{\rho_{in}}{\rho_{mid}} = 3 = x$

SECTION – C

14. 0.50

15. 2.50

Sol. (for Q. 14-15)

In steady state photo current = $\frac{IAe}{hf} = \frac{V}{R}$

16. 0.11

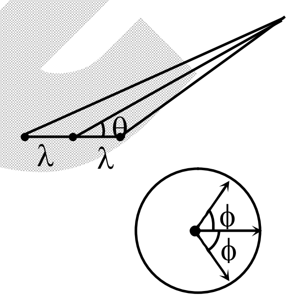
17. 5.83

Sol. (for Q. 16-17)

Path difference of S_1 and S_2 with S

$\Delta x = \lambda \cos\theta$

Resultant amplitude = A + 2A cos ($2\pi \cos\theta$)



Chemistry
PART – II

SECTION – A

18. B

Sol. $x = E_2 - E_1$

$$\text{or, } x = -\frac{E_H}{4} - (-E_H)$$

$$= \frac{-E_H + 4E_H}{4} = \frac{3E_H}{4} \text{ or, } E_H = \frac{4x}{3}$$

$\therefore \frac{3E_H}{4}$ energy required to excite the electron from ground state(E_1)

$$\therefore \frac{3E_H}{4} = x$$

$$\text{or, } E_H = \frac{-4x}{3}$$

19. A

Sol. The velocity is inversely proportional to the square root of molecular mass. The range will be wider if molecular mass is smaller.

20. B

Sol. $$\Lambda_m = K \times \frac{1000}{C} = 4 \times 10^{-3} \times \frac{1000}{0.02} = 200 \text{ ohm}^{-1}\text{cm}^2\text{mol}^{-1}$$

21. C

Sol. The products are
CH_3CHO two moles of formic acid and C_2H_5CHO.

22. AC

Sol. The nucleophiles contains two donor atoms.

23. AB

Sol. $$E_{Cell} = E^0_{Cell} - \frac{0.0591}{2}\log\frac{[Zn^{2+}]}{[Ag^+]^2}$$

$$= E^0_{Cell} - \frac{0.0591}{2}\log\frac{C_1}{(C_2)^2}$$

$E_{Cell} = E^0_{Cell}$, when $C_1 = C_2 = 1$ M or $C_2 = \sqrt{C_1}$

24. ABCD

Sol. $$3NH_4Cl + 3BCl_3 \xrightarrow[140-150^0C]{C_6H_5Cl} B_3N_3H_3Cl_3$$

$$B_3N_3H_3Cl_3 \xrightarrow{NaBH_4} B_3N_3H_6$$

SECTION – B

25. 20

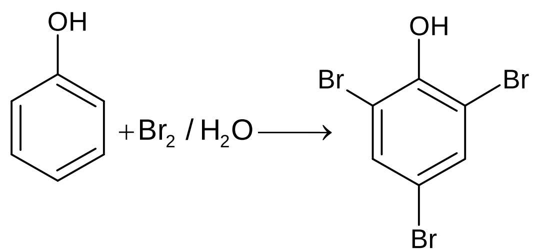
Sol. $\lambda = \frac{h}{\sqrt{2mE}} = \frac{6.6\times10^{-34}}{\sqrt{2\times9\times10^{-31}\times50\times10^{3}}} = \frac{6.6\times10^{-34}}{\sqrt{900\times10^{-28}}}$

$= \frac{6.6\times10^{-34}}{30\times10^{-14}} = 0.22\times10^{-20} = 0.22\times10^{-z}$

$\therefore$ z = 20

26. 331

Sol.



27. 140

Sol. $\Delta T_f = K_f m = 1.86 \times \text{one mole} \times \frac{1000}{W}$

or $1.86 \times \frac{1000}{W} = 3.72$

or W = 500 g

$\therefore$ Mass of ice formed = 640 – 500 = 140

28. 155

Sol. X = $K_2Cr_2O_7$, Y = CrO_2Cl_2, Z = Na_2CrO_4, Yellow ppt. = $PbCrO_4$

29. 579

Sol. Q = It

190.5 g Cu = 3 mole

½ mole Cu deposited by 1 F

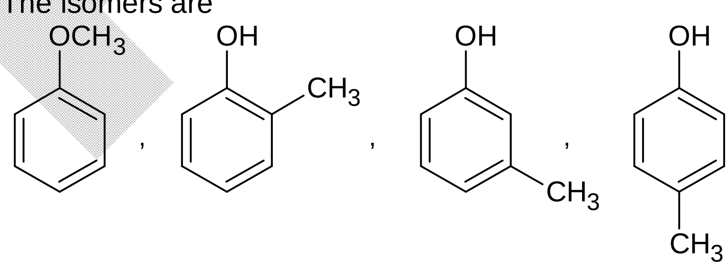
3 mole Cu deposited = 6 F = 6 × 96500 = 579000 coulomb

$\therefore$ x = 579000

Then $x \times 10^{-3} = 579$

30. 4

Sol. The isomers are



SECTION – C

31. 3.50

Sol. If 1 - α = 1, pH = $\frac{1}{2}\left[p^{K_a} - \log C\right]$

$$= \frac{1}{2}\left(5 - \log 10^{-2}\right) = \frac{1}{2}\left(5 + 2\right) = 3.5$$

32. 14.50

Sol. M_{eq} of CH_3COOH = 400 × 0.01 = 4

M_{eq} of NaOH = 500 × 0.01 = 5

$\therefore M_{eq}$ of excess NaOH = 1

$\therefore \left[OH^-\right] = \frac{1}{1000} = 10^{-3}$

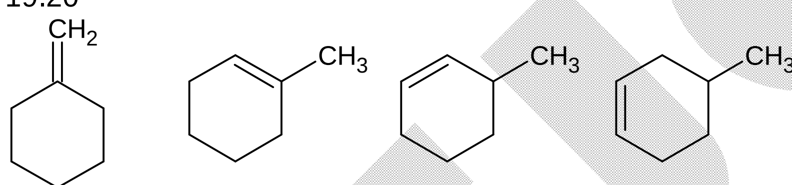
pOH = 3, pH = 11

$\therefore$ z = 11

$\therefore$ x + z = 3.5 + 11 = 14.5

33. 19.20

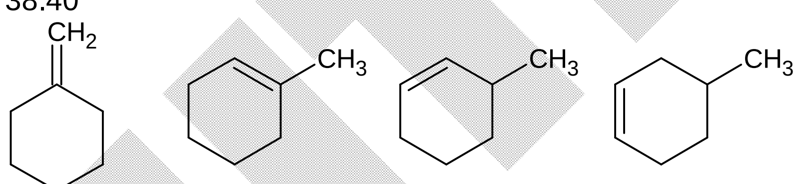
Sol.



(A) (B) (C) (D)

34. 38.40

Sol.



(A) (B) (C) (D)

Mathematics PART – III

SECTION – A

35. B

Sol. $J-I=\int\left(\frac{x+y}{xy}dy-\frac{x+y}{x^2}dx\right)$

$=\int\left(\frac{x+y}{x^2y}\right)(xdy-ydx)$

$=\int\left(\frac{x+y}{y}\right)\left(\frac{xdy-ydx}{x^2}\right)$

$=\int\left(\frac{x}{y}+1\right)d\left(\frac{y}{x}\right)$

$g(x)=\frac{y}{x}+\ell n\left(\frac{y}{x}\right)+c$

Put $x=1\Rightarrow 1=1+c\Rightarrow c=0$

$\therefore g(x)=\frac{y}{x}+\ell n\left(\frac{y}{x}\right)$

$g(e)=e+1$

36. C

Sol. Given, $\int_2^3 \underbrace{(3-x)}_{\text{I}}\underbrace{f''(x)dx}_{\text{II}}=7\Rightarrow (3-x)f'(x)\Big]_2^3+\int_2^3 f'(x)$

$dx=7$

$0-(f'(2))+f(3)-f(2)+7\Rightarrow f(3)=f'(2)+f(2)+7$

$=4+(-1)+7=10$

37. D

Sol. Let the coordinates of P be (α,β)

Then $PQ=2\beta$ and $OP=\sqrt{\alpha^2+\beta^2}$

Since OPQ is an equilateral triangle OP = PQ

$\Rightarrow\quad \alpha^2+\beta^2=4\beta^2\Rightarrow\alpha^2=3\beta^2$

$\Rightarrow\quad \alpha=\pm\sqrt{3}\,\beta$

Also since (α,β) lies on the given hyperbola, $\frac{\alpha^2}{a^2}-\frac{\beta^2}{b^2}=1$

$\Rightarrow\frac{3\beta^2}{a^2}-\frac{\beta^2}{b^2}=1\Rightarrow\frac{1}{b^2}=\frac{1}{\beta^2}>0\Rightarrow\frac{b^2}{a^2}>\frac{1}{3}$.

$\Rightarrow\ e^2-1>\frac{1}{3}\Rightarrow e^2>\frac{4}{3}\Rightarrow e>\frac{2}{\sqrt{3}}$

38. A

Sol. Let the radius of the smallest circle be a. We find that the radius of the largest circle is 4 – a and the radius of the second largest circle is 3 – a. Thus, $4-a+3-a=5 \Leftrightarrow a=1$. The radii of the other circles are 3 and 2. The sum of their areas is $\pi+9\pi+4\pi=14\pi \Leftrightarrow (E)$

39. AC

Sol. We have $f(x)-2\dfrac{\sin^2 x}{\cos^5 x}\underbrace{\int_0^{\frac{\pi}{4}}\cos t.f(t)\,dt}_{A(\text{say})}=\dfrac{\sin^2 x}{\cos^5 x}$

$\therefore\ f(x)-2A\dfrac{\sin^2 x}{\cos^5 x}=\dfrac{\sin^2 x}{\cos^5 x}$

$\Rightarrow f(x)=(2A+1)\dfrac{\sin^2 x}{\cos^5 x}$ ....(1)

Now, $A=\int_0^{\frac{\pi}{4}}\cos t.(2A+1).\dfrac{\sin^2 t}{\cos^5 t}dt=(2A+1)\int_0^{\frac{\pi}{4}}\dfrac{\sin^2 t}{\cos^4 t}dt$

$=(2A+1)\int_0^{\frac{\pi}{4}}\tan^2.\sec^2 t\,dt$

Put $\tan t=y\Rightarrow \sec^2 t\,dt=dy$

$\therefore$ We get $A=(2A+1)\int_0^1 y^2\,dy=(2A+1)\dfrac{1}{3}$

$\Rightarrow 3A=2A+1$

$\therefore A=1$

Hence from equation (1), we get

$\therefore\ f(x)=\dfrac{3\sin^2 x}{\cos^5 x}$

(A) Clearly, $\lim\limits_{x\to\frac{\pi}{3}} f(x)=\lim\limits_{x\to\frac{\pi}{3}}\dfrac{3\sin^2 x}{\cos^5 x}=\dfrac{3\left(\frac{\sqrt{3}}{2}\right)^2}{\left(\frac{1}{2}\right)^5}=72$

(B) As, $f(x)=\dfrac{3\sin^2 x}{\cos^5 x}$

So, $f(x)$ is periodic with period 2π.

(C) $f(x)=\dfrac{3\sin^2 x}{\cos^5 x}$

$\Rightarrow f'(x)$

$$= \left[\frac{\cos^5 x.(2\sin x.\cos x) + \sin^2 x.(5\cos^4 x.\sin x)}{\cos^{10} x}\right]$$

$\therefore f'(\pi) = 0$

$\Rightarrow M(x = \pi, y = 0)$

So, equation of normal to the graph of $f(x)$ at point M whose abscissa is π, is given by $x - \pi = 0$

(D) As, $f(x) = 0 \Rightarrow \dfrac{3\sin^2 x}{\cos^5 x} = 0 \Rightarrow \sin x = 0$

$\therefore x = n\pi, n \in I$

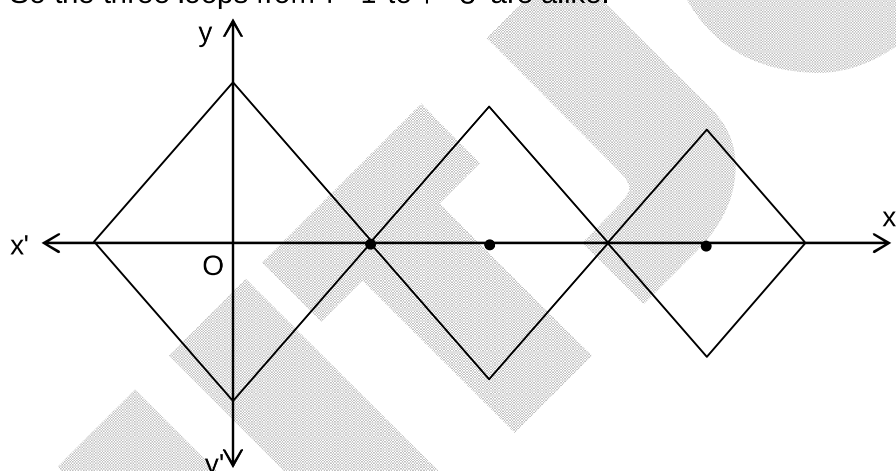
So, the equation $f(x) = 0$ has no root in (0, 3).

40. AC

Sol. $a_1 = 0, b_1 = 32, a_2 = a_1 + \dfrac{3}{2}b_1 = 48, b_2 = \dfrac{b_1}{2} = 16$

$a_3 = 48 + \dfrac{3}{2} \times 16 = 72, b_3 = \dfrac{16}{2} = 8$

So the three loops from $i = 1$ to $i = 3$ are alike.



Now area of i^{th} loop (square) $= \dfrac{1}{2}$ (diagonal)^2

$$A_i = \frac{1}{2}(2b_i)^2 = 2(b_i)^2$$

So, $\dfrac{A_{i+1}}{A_i} = \dfrac{2(b_{i+1})^2}{2(b_i)^2} = \dfrac{1}{4}$

So the areas form a G.P. series

So, the sum of the G.P. upto infinite terms.

$$= A_1 \frac{1}{1-r} = 2(32)^2 \times \frac{1}{1-\frac{1}{4}}$$

$$= 2 \times (32)^2 \times \frac{4}{3} = \frac{8}{3}(32)^2 \text{ square units.}$$

41. CD

Sol. $S_n = 1 + 22 + 33 + ... \underbrace{999....9}_{9 \text{ times}}$

$T_n = \underbrace{nnn....n}_{n \text{ times}}$

$= n\dfrac{\left(10^n - 1\right)}{9}$

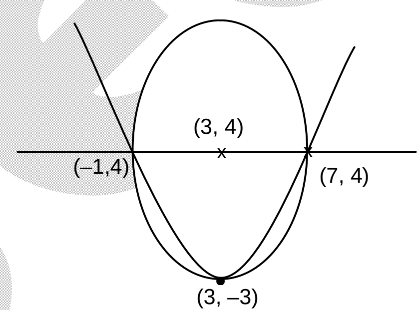
$T_n = S_n - S_{n-1} = \dfrac{n\left(10^n - 1\right)}{9}$

Also $S_3 = 356$

SECTION – B

42. 5

Sol. Given ellipse $\dfrac{(x-3)^2}{4^2} + \dfrac{(y-4)^2}{7^2} = 1$ (vertical ellipse)



Parabola can be taken as

$(x-3)^2 = A\,(y+3)$

It passes through (-1, 4)

$\Rightarrow 16 = 7A \Rightarrow A = 16/7$

$\therefore$ parabola is $7(x-3)^2 = 16y + 48$

$\therefore \quad 16y = 7(x-3)^2 - 48$

$\therefore$ A = 7, H = 3, K = 48

$\therefore \dfrac{A}{7} + \dfrac{H}{3} + \dfrac{K}{16} = 5$

43. 6

Sol. ${}^8C_7 \times {}^8C_6 + {}^8C_7 \times {}^7C_6 = 280$

44. 12

Sol. Let $a + c + 2b = x$ …(1)

$a + b + 2c = y$ ….(2)

$a + b + 3c = z$ ….(3)

$c = z - y; b = x + z - 2y$

$a = -x + 5y - 3z$

$\left(\dfrac{2y - x}{x}\right) + \dfrac{4(x + z - 2y)}{y} - \dfrac{8(z - y)}{z}$

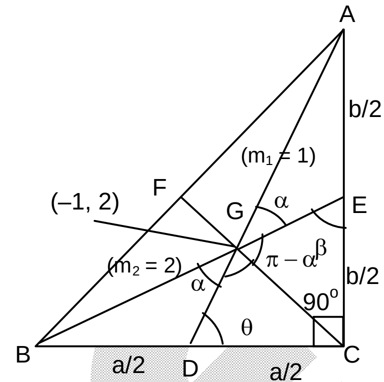
$= -17 + 2\left(\dfrac{y}{x} + \dfrac{2x}{y}\right) + 4\left(\dfrac{z}{y} + \dfrac{2y}{z}\right)$

$= -17 + 4\sqrt{2} + 8\sqrt{2}$

$= 12\sqrt{2} - 17$

45. 400

Sol. Area $=\frac{1}{2}ab$



$AD: y = x + 3$

$BE: y = 2x + 4$

solve $G(-1, 2)$

acute angle α between the median is $\tan\alpha = \frac{m_1 - m_2}{1 + m_1 m_2}$

$\tan\alpha = \frac{2-1}{1+2} \Rightarrow \tan\alpha = \frac{1}{3}$

now $(180-\alpha) + 90^o + \theta + \beta = 360^o$

$\Rightarrow \quad \alpha = \theta + \beta - 90^o$

$\cot\alpha = -\tan(\theta+\beta)$

$-3 = \frac{\tan\theta + \tan\beta}{1 - \tan\theta\tan\beta}$ or $-3 = \frac{\frac{2b}{a} + \frac{2a}{b}}{1 - \frac{2b}{a}.\frac{2a}{b}} \Rightarrow 9 = \frac{2(a^2+b^2)}{ab}$

$9ab = 2\times 360 \quad \Rightarrow \quad \frac{1}{2}ab = 400$

$\therefore$ Area = 400 sq. units

46. 15

Sol. $V_2 = \begin{vmatrix} 1 & 1 & -2 \\ 3 & -2 & 1 \\ 1 & -4 & 2 \end{vmatrix} \left[\vec{a} \quad \vec{b} \quad \vec{c}\right]$

$= 15v_1$

$\frac{V_2}{V_1} = 15$

47. 171

Sol. Maximum number of points of intersection possible if there are no constraints $= {}^{20}C_2 = 190$. But 5 of these 20 lines are parallel. There will not be any intersection point from these 5 lines.

$\therefore$ Maximum number of points of intersection $= 190 - {}^5C_2 = 180$. Also the times $L_1, L_5, L_9, L_{13}, L_{17}$ pass through one point.

$\therefore$ We need to replace ${}^5C_2\,(=10)$ points by 1.

$\therefore$ The maximum number of points of intersection $= 190 - 10 - 10 + 1 = 171$

SECTION – C

48. 6.00

49. 321.00

Sol. (Q.48 – 49)
We have, $f(x) = (x-a)^3 + b$ ....(i)
Since, Rolle's theorem is applicable to $g(x)$ at $x = 2$,
So $g(a) = g(b)$ and $g'(2) = 0$
$\Rightarrow 0 = f(b) - f(a) + (a-b)f'(b) + 3(b-a)^2$ and $(a-2)f''(2) + 6(2-a) = 0$
$\therefore\ f'(b) = \dfrac{f(b)-f(a)}{b-a} + 3(b-a)$ ......(ii)
and $f''(2) = 6$ ....(iii)
(As $a \neq 2$, think)
(i) As, $f''(2) = 6$ [using (iii) in (i)]
$\Rightarrow\ 6(2-a) = 6 \Rightarrow a = 1$.
(ii) Using (i) in (ii), we get
$(b-a) = \dfrac{3}{2} \Rightarrow b = \dfrac{5}{2}$.
$\therefore\ \int_1^{\frac{5}{2}} \left((x-1)^3 + \dfrac{5}{2}\right) dx = \dfrac{321}{64}$

50. 5.00
Sol. Let $P(i)$ be the probability that exactly I students are passing an examination.
Now given that
$P(A_i) = \lambda_i^2$ (where λ is constant)
$\Rightarrow \sum_{i-1}^{10} P(A_i) = \sum_{i-1}^{10} \lambda i^2 = \lambda \dfrac{10 \times 11 \times 21}{6} = \lambda$
$\times 386 = 1$
$\Rightarrow \lambda = \dfrac{1}{358} = \dfrac{5}{77}$.

51. 2.00
Sol. Now $P\left(\dfrac{A_i}{A}\right) = \dfrac{\left(\dfrac{PA}{A_i}\right) P(A_i)}{P(A)}$
$= \dfrac{\dfrac{1}{385} \times \dfrac{1}{10}}{\dfrac{11}{14}}$
$= \dfrac{1}{11 \times 55} \times \dfrac{1}{5} = \dfrac{1}{3025}$