BYJU'S CLASSES

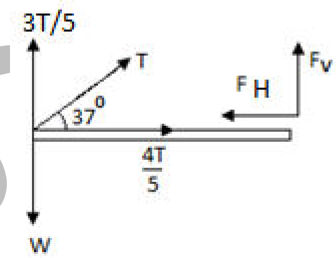
PHYSICS JEE ADVANCED SAMPLE PAPER – 1

ANSWER KEY:

1.D	**2.A**	**3.A**	**4.B**	**5.C**	**6.B**	**7.B**	**8.A**	**9.D**	**10.B**
11.B, C	**12.B,D**	**13.A,D**	**14. A,D**	**15. A,C,D**	**16.1**	**17.3**	**18.3**	**19. 2**	**20.1**

Section - I

1. Ans. (d)



It is based on concept of tension in string which is mass less. Then the tension T has the same magnitude at all points throughout the string.
The magnitude of acceleration of any number of mass connected through the string is always same.
Torque about hinge will be zero. So,

$WL = \frac{3TL}{5}$

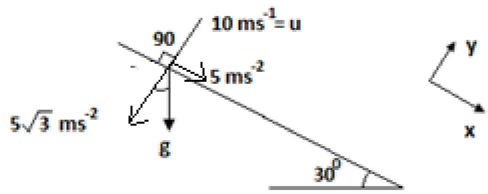
$\Rightarrow W = \frac{3T}{5}$

$T = \frac{5W}{3} = \frac{1000\text{ N}}{3}$

Also, $F_V + \frac{3T}{5} = mg \Rightarrow F_V = 0$

$F_H = \frac{4T}{5} = \frac{800\text{ N}}{3}$

2. Ans. $T = \frac{2\times 10s}{5\sqrt{3}}$



Range along incline,

$R = u_x T + \frac{1}{2}a_x T^2 = (0\times T) + \left[\frac{1}{2}\times 5\times\left(\frac{2\times 10}{5\sqrt{3}}\right)^2\right]$

$\Rightarrow R = \frac{40\text{m}}{3}$

3. Ans: Use, $a = v\frac{dv}{dx}$

$a = x^3 - 3x = v\frac{dv}{dx} \Rightarrow \int_0^v v\,dv = \int_1^3 (x^3 - 3x)dx$

$\Rightarrow v = 4\text{ms}^{-1}$

4. Ans. (B)

Use, $e = \frac{\text{separation speed}}{\text{approach speed}}$

If e=0, then it will be inelastic collision and e=1 for an elastic collision.
Velocities after collision are related by,

$mv = mv_1 + mv_2$

$ev = v_2 - v_1$

Solving, we get, $v_2 = \left(\frac{1+e}{2}\right)v, v_1 = \left(\frac{1-e}{2}\right)v$

$\because \frac{(V_A)AFC}{(V_B)BFC} = \frac{1+e}{2}$

$\frac{V_1}{V_2} = \frac{1-e}{1+e}$

5. Ans. (C)

Since no external force is applied, the linear momentum is conserved. Hence, $V_{CM}=0$

Moment of inertia of the system is,

$I = 2ma^2+m(2a)^2+[\frac{1}{12}\times 8m\times(6a)^2]=30ma^2$

Since no external torque is applied, the angular momentum of the system is conserved.

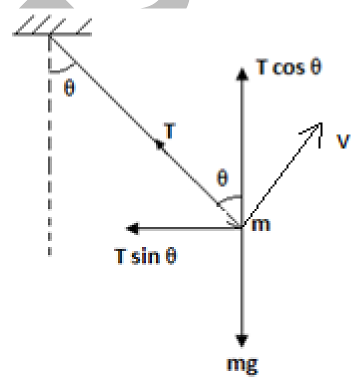
$\Rightarrow (2mv\times a)+(m\times 2v\times 2a)=Iw$

$\Rightarrow 6\ mva=30\ ma^2 w \Rightarrow w = \frac{v}{5a}$

Total K.E= K.E of rotation $= \frac{1}{2}Iw^2$

$= \frac{1}{2}(30ma^2)\left(\frac{V}{5a}\right)^2 = \frac{3}{5}mv^2$

6. Ans. (B)



$T\cos\theta = mg$

$\Rightarrow T = \frac{mg}{\cos\theta}$

Increase in the length

Of wire is, $\Delta l = \frac{TL}{AY}$

Strain $= \frac{\Delta l}{L} = \frac{mg}{AY\cos\theta}$

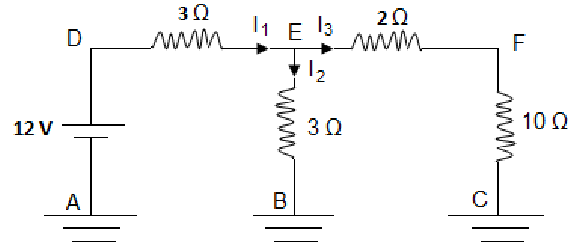
7. Ans. (B)

F= qE . $S = \frac{1}{2}at^2 \Rightarrow S = \frac{1}{2}\left(\frac{qE}{m_e}\right)t^2$

$S_e = \frac{1}{2}\left(\frac{qE}{me}\right)t^2$ and $S_p = \frac{1}{2}\left(\frac{qE}{m_p}\right)t^2$

$S_e = S_p \Rightarrow \frac{t_1^2}{me} = \frac{t_2^2}{mp} \Rightarrow \frac{t_2}{t_1} = \left(\frac{m_p}{m_e}\right)^{1/2}$

8. Ans.(A)



Here, $V_A=V_B=V_C=0$

$V_D=12V$

$V_D-V_E=12-V=V_1$

$V_E-V_B=V$

$V_E-V_C=V$

$\therefore I_1 = \frac{12-V}{3}, I_2 = \frac{V}{3}, I_3 = \frac{V}{12}$

Apply Kirchhoff's junction rule, $I_1=I_2+I_3$

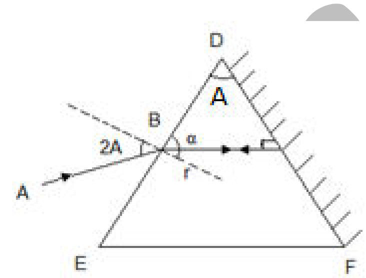
i.e., $\frac{12-V}{3} = \frac{V}{3} + \frac{V}{12} \Rightarrow \frac{16}{3}V$

Hence, $I_3 = \frac{(\frac{16}{3})}{12} = \frac{4}{9}A$

9. Ans.(D)

When it is completely inside the field the flux remains constant but it changes at the time of entry and exit. This is opposed (Lenz's law).

10. Ans.(B)



$\alpha = 90^0 - A$

Hence r = A

$\mu = \frac{\sin i}{\sin r} = \frac{\sin 2A}{\sin A}$

$\Rightarrow \mu = \frac{2 \sin A \cos A}{\sin A} = 2 \cos A$

Section - II

This section contains to multiple choice questions, with more than one correct answer.

11. Ans.(B) and (C)

Centripetal forces $F_C = \frac{mv^2}{r} = \frac{mk^2t^2}{r}$

$P = \overrightarrow{F_c}.\vec{v} = 0$

$F_t = m\left(\frac{dv}{dt}\right) = m\frac{d}{dt}(kt) = mk$

$P = \overrightarrow{F_t}.\vec{v} = mk^2t$

12. Ans. (B) and (D)

For a diatomic gas, $C_P + C_V = \frac{7R}{2} + \frac{5R}{2} = 6R$

For a mono atomic gas, $\frac{5R}{2} + \frac{3R}{2} = 4R$

$C_P.C_V$ for diatomic gas = $\frac{35R^2}{4}$

And for monatomic gas = $\frac{15R^2}{4}$

$\frac{C_p}{C_v} = \gamma = 1 + \frac{2}{f}$ is smaller for diatomic gas than for monatomic gas.

$C_P - C_V = R$

13. Ans. (A) and (D)

Plate 1 is connected to the positive terminal of the battery and plate 2 is connected to the negative terminal. Hence, $Q_1 = CV = \frac{\epsilon_0 AV}{d}$ plates 1,2,4 and 5 constitute 2 capacitors in parallel; their combined capacitance is, $C^1 = 2C$.

The charge on plate 4 is negative because it is connected to the negative terminal of the battery.

14. Ans.(A) and (D)
The angular width of the central maximum is 2λ/a where a is the width of the slit. If the value of a is doubled, the angular width of the central maximum decreases to half its earlier value. This implies that the central maximum becomes much sharper. Furthermore, if a is doubled, the intensity of the central maximum becomes four times. Thus the central maximum becomes much sharper and brighter.

15. Ans. (A),C) and D)
The distance of closest approach is given by, $r_0 = \frac{1}{2\pi\epsilon_0}\frac{qZe}{mv^2}$
q, m and v are charge, mass and velocity of incident particle and Z is the atomic number of the target nucleus.

SECTION - III

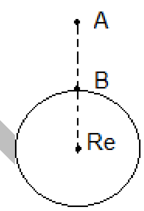
This section contains 5 integer type questions.

16. Ans. 1

$W_{ext\,(A\to B)} = (V_B - V_A)m$

$= \left[\frac{-GM_e}{R_e} - \left(-\frac{GM_e}{2R_e}\right)\right] m = \left[\frac{-}{2}\frac{GM_e}{R_e}\right] m$

Compare it with $\frac{-X\,GM_e m}{2R_e}$



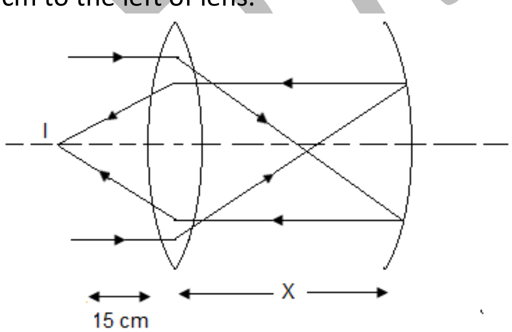
17. Ans. 3
Cylinder can perform SHM only till it is partially submerged. When cylinder goes down by x inside the liquid level comes up by x^1,

$(4a-a)x^1 = xa \Rightarrow x^1 = \frac{x}{3}$

18. Ans. 3
When the end B hits the floor, the vertical distance through which C (the mid point) falls is L/2. From the law of conservation of energy, Loss of P.E = Loss of K.E.

$$Mg\frac{L}{2} = \frac{1}{2}I\omega^2 = \frac{1}{2}\frac{ML^2}{3}\omega^2 \Rightarrow \sqrt{\frac{3g}{L}}$$

19. Ans. 2
It is possible only when the focusof the lens and mirror coincide. Then, the final image is at 15cm to the left of lens.



X = 15+21=36 cm

$\Rightarrow \frac{x}{18} = 2\text{ cm}$

20. Ans. 1

Charge on the inner sphere is, $q = cV = 4\pi\varepsilon_0 rV$

The potential difference between the two spheres is,

$$V' = V_1 - V_2 = \frac{q}{4\pi\varepsilon_0}\left(\frac{1}{r} - \frac{1}{2r}\right) = \frac{q}{4\pi\varepsilon_0}\frac{1}{2r} = \frac{V}{2}$$

CHEMISTRY SOLUTIONS

21.C	**22.A**	**23.B**	**24.D**	**25.C**	**26.B**	**27.C**	**28.B**	**29.D**	**30.A**
31.B,C	**32.B,C,D**	**33.B,D**	**34.B,D**	**35.B,D**	**36. 0**	**37. 6**	**38. 3**	**39. 2**	**40. 3**

21. Ans: (C)

Solution:

$P_A^0 X_A + P_B^0 X_B = P_{mix}$

$(520)\, X_A + (1000)(1 - X_A) = 760$

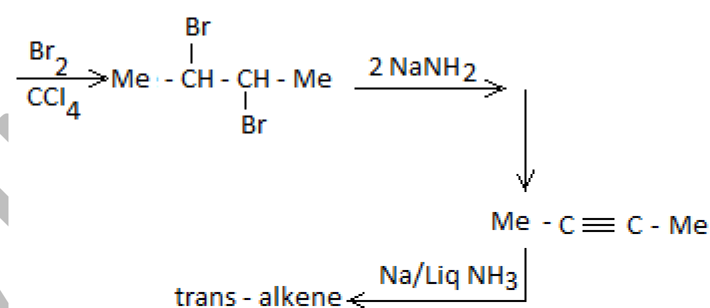
$520\, X_A - 1000\, X_A = 760 - 1000$

$-480\, X_A = -240$

$\therefore X_A = \frac{1}{2} = 0.5$

22. Ans: (A)

Solution: me – CH = CH – me



23. Ans: (B)

Solution: 1st titration

Meq. Of NaOH + $\frac{1}{2}$ $m.eq$ of Na_2CO_3 = meq of HCL = 50 × $\frac{1}{10} = 5$

2nd titration

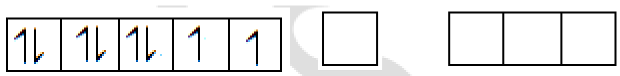
$\frac{1}{2}$ $meq$of$Na_2CO_3 = m\,eq.of\ HCL = 10 \times \frac{1}{10} = 1$

$\therefore M\ eq\ of\ NaOH = 5 - 1 = 4$

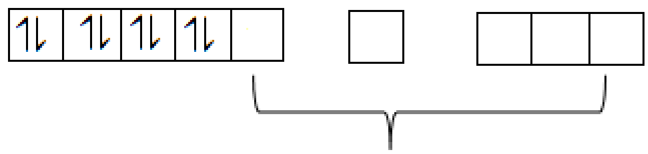
Lot of NaOH = $\frac{4 \times 40}{100} = 0.16gr$

24. Ans: - (D)

Solution: $Ni^{+2} \rightarrow 3d^8 4s^\circ 4P^\circ$



$C\overline{N}$, strong field ligand regroups the electrons



dsp^2hybridization

25. Ans: (C)

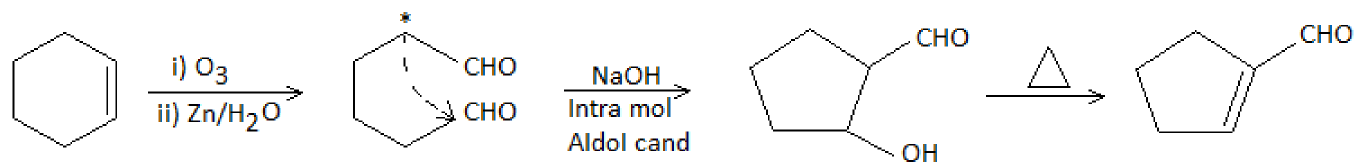
Solution: In chain and cyclic silicates with the formula $(SiO_3)_n^{-2n}$, two oxygens are shared.

26. Ans: (B)

Solution: NCl_3 on hydrolysis gives NH_3&HOCl but not HNO_2

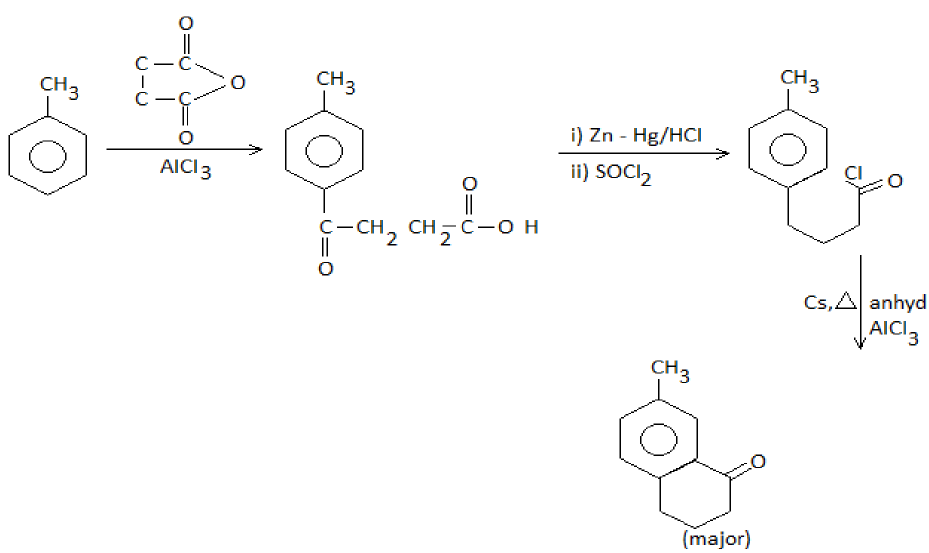
27. Ans: (C)

Solution:



28. Ans: (B)

Solution:



29. Ans: (D)

Solution: N_2O doesnot have unpaired electrons

30. Ans: (A)
Solution: For a concentration cell

Anode: $\underset{P_1}{H_2} \longrightarrow \underset{1m}{2H^+} + 2\bar{\imath}$

Cathode: $\underset{1m}{2H^+} + 2\bar{\imath} \longrightarrow \underset{P_2}{H_2}$

$H_{2P_1} \longrightarrow H_{2P_2}$

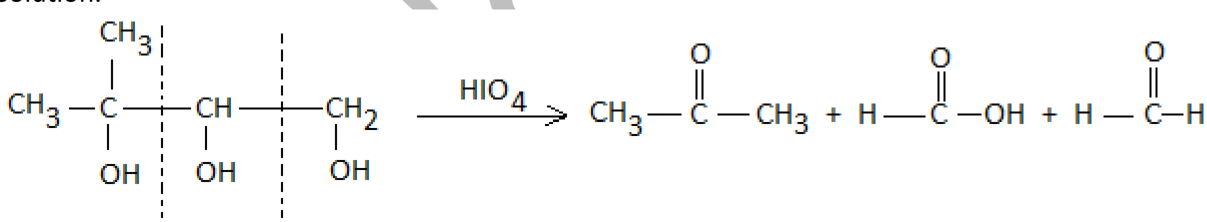
$Q_c = \frac{P_2}{P_1}$

E = $E^\circ - \frac{0.059}{n}\log Q_c = -\frac{0.059}{1}\log\frac{P_2}{P_1}$
= 0.059 log $\frac{P_1}{P_2}$

MCQ with one or more is Correct:

31. Ans: B, C
Solution: Absolute configuration of (b) is (2R, 3S)
Absolute Configuration of (c) is (2R, 3S)

32. Ans: B, C, D
Solution:



33. Ans: B, D
Solution: Conceptual

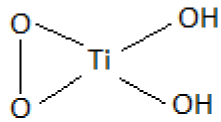
34. Ans: B,D
Solution: Conceptual

35. Ans: A,B,D
Solution: Malachite &whitherite are carbonate ores.
Argentite is Ag_2s& pyrolusite is $\mathrm{Mno_2}$

INTEGER TYPE QUESTIONS

36. Ans: (0)

Solution: $H_2O_2 + TiO_2 + H_2SO_4 \longrightarrow H_2TiO_4$(Orange)
Pertitanic acid



has a Peroxy band.

∴ O. State of Ti = + 4

37. Ans: (6)

Solution: $C_xH_y + \left(x + \frac{y}{4}\right)O_2 \longrightarrow x\,CO_2 + \frac{Y}{2}H_2O_{(l)}$

5Ml 30Ml

0 $30 - 5\left(x + \frac{y}{4}\right)$ $5x$

∵ 5x = 10 ⟹ x = 2

$$5\left(x + \frac{y}{4}\right) = 15 \Rightarrow y = 4$$

∴ formula of Hydrocarbon = C_XHy

X + y = 2 + 4 = 6

38. Ans: (3)

Solution: Phenols & alcohols donot given CO_2 with $NaHCO_3$

39. Ans: (2)

Solution: Consider the unit cell face

So, atoms of Face will be = 4 × $\frac{1}{8} + \frac{1}{2} \times 1 = 1\ atom$ no. of atoms at one face of crystal = $\frac{1}{6} \times 10^{30} = 10^{30}$ atoms. So, no. of unit cells of edge of crystal = $\sqrt{10^{30}} = 10^{15}$

Now edge length of one unit cell = $\frac{4}{\sqrt{2}} \times 50 \times 10^{15}\ nm$

So, area of face of crystal = $\left(\frac{4}{\sqrt{2}} \times 50 \times 10^{15}\right)^2 nm^2$

= $\frac{16}{2} \times 25 \times 10^2 \times 10^{30} = 2 \times 10^{34} nm^2$

= $2 \times 10^{34} \times 10^{-18} m^2 = 2 \times 10^{16} m^2$

40. Ans: (3)

Solution: NO_2 , ClO_2, and Cl_2O_6

MATHEMATICS
SOLUTION
Answer key

41. C	**42. A**	**43. B**	**44. D**	**45. B**	**46. A**	**47. D**	**48. B**	**49. D**	**50.A**
51. A	**52. A**	**53. B,C**	**54. B,D**	**55. A,C**	**56. 4**	**57. 9**	**58. 7**	**59. 3**	**60. 1**

41. radius, r = 1 + $\frac{1}{2} = \frac{3}{2} \Rightarrow P = 2\pi = 3\pi$

42. $am^2 = \ln \Rightarrow a(1)^2 = (1)(2) \quad \Rightarrow a = 2$

$\therefore A = (2, -4),\ B = (-2, 0), C = (0, -2) \Rightarrow AC.BC = 8$

43. The sides are x = 2, x = 3, y = 1, y = 5

$\therefore$ *vertices are* $A\ (2,1), B\ (3,1), C\ (3,5), D\ (2,5)$

Eqn of AC (+ve slope) is y = 4x – 7

44.$\cos\theta \,.\, \cos 2\theta \ldots\ldots\ldots\ldots\ldots \cos 2^{n-1}\,\theta = \frac{\sin 2^n\theta}{2^n \sin\theta}$

$\text{Cos}\frac{x}{2}.\cos\frac{x}{4}\ldots\ldots\ldots\ldots\cos\frac{x}{2^n} = \frac{\sin x}{2^n \sin\left(\frac{x}{2^n}\right)}$

$\Rightarrow \underset{n\,\rightarrow\,\infty}{Lt} \frac{\sin x}{2^n \sin\left(\frac{x}{2^n}\right)} = \frac{\sin x}{x}$

45. y = $tan^{-1}\left(\frac{5x-x}{1+5x\,.x}\right) + tan^{-1}\left(\frac{\frac{2}{3}+x}{1-\frac{2}{3}.x}\right) = tan^{-1}\,5x + tan^{-1}\frac{2}{3}$

$\frac{dy}{dx} = \frac{5}{1+25\,x^2} \Rightarrow at\ x = 1/5, \frac{dy}{dx} = \frac{5}{2}$

46. I = $\int \frac{1}{sin^{\,2010}x} sin^2x\,dx - \int \frac{2010}{sin^{2010}x}\,dx$

= $\frac{\tan x}{sin^{2010}x} + c \qquad \Rightarrow f(x) = \tan x \qquad \Rightarrow f\left(\frac{\pi}{3}\right) = \sqrt{3}$

47. $e^{-x}\,f(x) = 2 + \int_0^x \sqrt{t^4+1}\,dt \qquad \Rightarrow dx$

$e^{-x}(f^1(x) - f(x)) = \sqrt{x^4+1} \Rightarrow f^1(0) = 3$

48. A = $\int_0^1 (2x - 2x^2 - x\log x)\ \ dx$

$= \left[x^2 - \frac{2x^3}{3} - \frac{x^2}{x}\log x + \frac{x^2}{4}\right]_0^1$

= 1 - $\frac{2}{3} + \frac{1}{4} = \frac{7}{12}\left(\because \underset{x\,-\,0}{lt} x^2.\log x = 0\right)$

49. Given eqn. in $\frac{y\,dx-xdy}{y^2} + dy = 0 \Rightarrow d\left(\frac{x}{y}\right) + dy = 0$

$\Rightarrow \frac{x}{y} + y = c, \qquad but\ y\ (1) = 1 \qquad \Rightarrow C = 2$

$\therefore \frac{x}{y} + y = 2 \qquad \Rightarrow\ x + y^2 = 2y \qquad \Rightarrow (y-1)^2 = -(x-1)$

50.y = $x^3 \Rightarrow \frac{dy}{dx} = 3x^2 \qquad\qquad let\ A\ (x_1,\ x_1^3)\ , B\ (x_2\ , x_2^3)$

$m_A = 3x_1^2 = \frac{x_2^3 - x_1^3}{x_2 - x_1} = x_2^2 + x_1x_2 + x_1^2$

$\Longrightarrow x_2^2 + x_1x_2 - 2x_1^2 = 0 \Longrightarrow (x_2 - x_1)(x_2 + 2x_1) = 0$

$\therefore\ x_2 = -2x_1 (\because\ x_1 \neq x_2)$

K = $\frac{m_B}{m_A} = \frac{3x_2^2}{3x_1^2} = 4$

51. No. of ways = $\frac{(200)!}{2^{100}(100)!}$

= 1.3.5 ……………. 199

= $\left(\frac{101}{2}\right)\left(\frac{102}{2}\right) \ldots \ldots \ldots \ldots \left(\frac{200}{2}\right)$

52. let P (E) = X, p (F) = y

X + y – 2xy = $\frac{11}{25}$, $(1-x)(1-y) = \frac{2}{25} \Longrightarrow xy = \frac{12}{25}, x + y = \frac{7}{5}$

$\Longrightarrow x = \frac{4}{5}, y = \frac{3}{5} (or) \quad x = \frac{3}{5}, y = \frac{4}{5}$

53. Given sum = $n_{co} \int_0^1 x^{n-1}\, dx + n_{c1} \int_0^1 x^n\, dx + \cdots \ldots \ldots \ldots \ldots \ldots + nc_n \int_0^1 x^{2n-1}\, dx$

= $\int_0^1 [nc_0 \,.\, x^{n-1} + nc_1 . x^n + \cdots \ldots \ldots \ldots + nc_n \,.\, x^{2n-1}]\, dx$

= $\int_0^1 x^{n-1}(1+x)^n\, dx \quad = \quad \int_1^2 (x-1)^{n-1} \;.\; x^n \;\; dx$

54. f(x) = $Tan^{-1} x + sin^{-1} x + cos^{-1} x$

Common domain is x ∈ $[-1, 1]$

$\therefore f(x) = Tan^{-1} x + \frac{\pi}{2}$

f(-1) = $-\frac{\pi}{4} + \frac{\pi}{2} = \frac{\pi}{4}$

f(1) = $\frac{\pi}{4} + \frac{\pi}{2} = \frac{3\pi}{4}$

55. expand det. And equate
A = 1, B= -1, C = -12, D = 12, E = 0

56. -2 $\leq \frac{4m-6}{4-m} \leq 2 \;\; \Rightarrow m \in \left[-1, \frac{7}{3}\right]$
⇒ m = -1, 0, 1, 2

57.Let Z = x+iy⇒ x + iy +$\sqrt{x^2 + y^2} = 2 + 8i$

X+$\sqrt{x^2 + y^2} = 2,\ y = 8 \quad \Rightarrow x = -15$
$|z| = 17$

58. Let A (2λ+1, 4λ+3, 3λ+2) be a point on the line
Dirt fm A to the plane = dirt from p to the plane
⇒λ=2
∴ A = (5, 11, 8) and PA = 7

59. $(\bar{b})^2 = (2\bar{c} + \lambda\bar{a})^2 \quad \Longrightarrow |\bar{b}|^2 = 4|\bar{c}|^2 + \lambda^2|\bar{a}|^2 + 4\lambda(\bar{a}.\bar{c})$
⇒ 16 = 4+λ^2+λ $(\bar{a}.\bar{c} = \frac{1}{4})$
$\lambda^2 + \lambda - 12 = 0$
(λ+4)(λ – 3) = 0 ⇒ λ = -4, 3

60. Given eqv is $4(x-1)^2 + 9(y-2)^2 = 36$ wihich is an ellipse
C = (1, 2)
Let CA makes an angle ϑ with the major axis
A = (1 + CA cos θ, 2 + CA sin θ)
B = $\left(1 + CB\, cos\left[\frac{\pi}{2} + \vartheta\right], 2 + \mathrm{CB}\sin\left[\frac{\pi}{2} + \vartheta\right]\right)$
A, B then on the ellipse
$\Longrightarrow \mathrm{CA}^2(4\cos^2\vartheta + 9\sin^2\vartheta) = 36$
$\mathrm{CB}^2(4\sin^2\vartheta + 9\cos^2\vartheta) = 36$
$\Longrightarrow \mathrm{CA}^{-2} + \mathrm{CB}^{-2} = \frac{13}{36}$