# FIITJEE

# Solutions to JEE (Main)-2020

**JEE–Main–2020 –Sept–5–First–Shift**
**PHYSICS, CHEMISTRY & MATHEMATICS**

## PART –A (PHYSICS)

1. **D**

Sol. As it just floats B = mg

$$\left(\frac{4\pi R^3}{3}\right)(\rho_\ell)(g) = \left(\frac{4\pi R^3}{3} - \frac{4\pi r^3}{3}\right)(\rho_s)(g)$$

$$R^3 = (R^3 - r^3)\left(\frac{27}{8}\right)$$

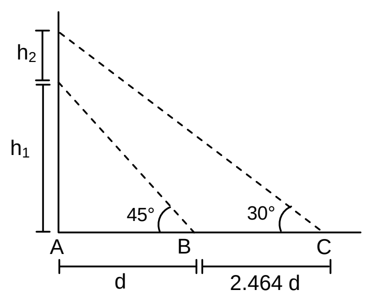
On solving we get,

$$r = \frac{8}{9}R \text{ (approx)}$$

2. **D**

Sol.

$$\frac{h_1}{d} = 1$$




$$\frac{h_1 + h_2}{3.464d} = \frac{1}{\sqrt{3}}$$

$$d + h_2 = \frac{3.464d}{\sqrt{3}}$$

$h_2 = 2d - d = d$

3. **D**

4. **No option.**

5. **A**

Sol. As $\text{Torque}_{net} = 0$

Hence, L = constant

$I\omega = (3I + I)\omega'$

$$\omega' = \frac{\omega}{4}$$

Loss in K.E. = $\frac{1}{2}I\omega^2 - \frac{1}{2}(I + 3I)\frac{\omega^2}{16}$

$$= \frac{1}{2}I\omega^2\left(1-\frac{1}{4}\right)$$

Fractional loss = $\dfrac{\frac{1}{2}I\omega^2\,\frac{3}{4}}{\frac{1}{2}I\omega^2} = \dfrac{3}{4}$

6. **B**

Sol. $f = \dfrac{V(n)}{4\left(1-\frac{17}{100}\right)}$ (as closed from end)

$$f = \frac{(n-2)(v)}{4\left(1-\frac{24.5}{100}\right)}$$

$$\frac{nV(100)}{4(83)} = \frac{(n-2)(v)(100)}{(4)(75.5)}$$

75.5 n = 83 (n – 2)

75.5 n = 83 (M – 2)

7.5 n = 166

n = 22 (approx)

$f = \dfrac{(330)(22)(100)}{4(83)}$ = 2200 Hz

7. **D**

Sol. $\dfrac{E_0}{B_0} = C$

$$B_0 = \frac{E_0}{C}$$

Force, $F_{max}$ = QVB

8. **D**

Sol. Photodiode operate in reverse bias. The photocurrent increases initially and saturates finally.

9. **C**

Sol. $\dfrac{1}{4}m(210)^2 = m(0.03)\times(4.2)\times1000\times\Delta T$ ; Q = mS$\Delta$t

$\Delta T = \dfrac{(210)(210)}{(4)(4.2)(0.03)(1000)}$ = 87.5°C

10. **C**

Sol. $g' = g\left(\dfrac{R}{R+h}\right)^2$ above

$g' = g\left(\frac{2}{3}\right)^2 \qquad h = \frac{R}{2}$

$g' = g\left(1 - \frac{d}{R}\right) \qquad$ above

$1 - \frac{d}{R} = \frac{4}{9} \qquad \frac{d}{R} = \frac{5}{9}$

11. **B**

Sol. V is always less than u.

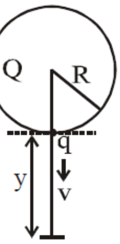
$\frac{1}{v} - \frac{1}{u} = \frac{1}{F}$

$\frac{1}{v} = \frac{1}{u} + \frac{1}{F}$

V = $\frac{uF}{u+F} = \frac{u}{\left(\frac{u}{F}+1\right)}$

12. **B**

Sol.

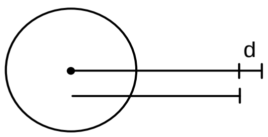



$dw_{ef}$ = Eqdx

$\int du_{et} = \int \frac{kQ}{x^2} dxq$

= $kQq\left(-\frac{1}{2}\right)_R^{R+y}$

$W_{ef} = \frac{kQq(y)}{(R)\,(R+y)}$




$W_{all} = \Delta k$

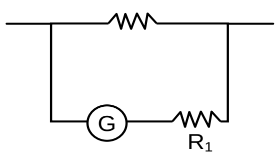
$W_{mg} + W_{ef} = \frac{1}{2}mv^2$

$V^2 = \frac{2}{m}\left(\frac{kQqy}{(R)\,(R+y)} + mg\,y\right)$

$V^2 = 2y\left(\frac{kQq}{m(R)\,(R+y)} + g\right)$ ; $k = \frac{1}{4\pi\varepsilon_0}$

13. **A**

Sol.




$V = I_G\,(G + R_1)$

$1 = I_G\,(G + R_1)$ ...(1)

$2 = I_G\,(G + R_1 + R_2)$

$2 = 1 + I_G R_2$

$I_G R_2 = 1$

$R_2 = G + R_1$

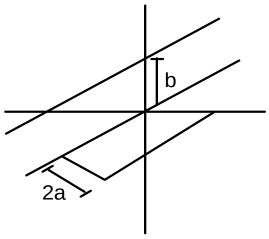
14. **D**

Sol. Use the equation to find 'N':

$$P = \frac{2}{3}\left(\frac{N}{V}\right)\left(\frac{1}{2}mu^2\right)$$

15. **D**

Sol. $\vec{B}_1 = \frac{\mu_o I}{2\pi(\ell)}$

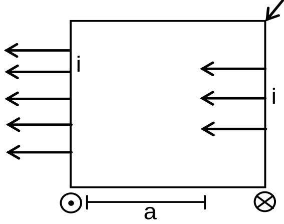



$|\vec{\tau}| = |\vec{r} \times \vec{F}|$

$\tau = 2aF$

$\tau = 2(a)(I)(2a)\left(\frac{\mu_o I}{2\pi b}\right)$

$\tau = \frac{2\mu_o I^2 a^2}{\pi b}$




B on the also equal to $B_1$ as

$$B = \frac{\mu_0 I}{2\pi\sqrt{b^2 + \frac{\mu_0^2}{4}}}$$

b >>> a

16. **C**

Sol. $\text{disp} = \left(\frac{kg}{ms^2}\right)\left(\frac{s}{m}\right)(s)\left(\frac{m^3}{kg}\right)$

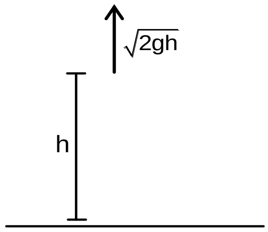
$\text{disp} = (1)(16)\left(\frac{1}{300}\right)\left(\frac{1}{1000}\right)(1)$

$\text{disp in mm} = \frac{1000}{300 \times 100} = 0.03333$

$\Rightarrow \quad \frac{3}{100}$

17. **C**

Sol.




$V^2 = 2gh$

$V = \sqrt{2gh}$

$h = -\sqrt{2gh} + \frac{gt^2}{2}$

$gt^2 - 2\sqrt{2gh}\,t - 2h = 0$

$t = \frac{2\sqrt{2gh} \pm \sqrt{8gh + 8gh}}{2g}$

$t = \frac{2\sqrt{2gh} + 4\sqrt{gh}}{2g}$ as cannot be negative.

$\therefore \quad t = (2+\sqrt{2})\sqrt{\frac{h}{g}} \Rightarrow 3.4\sqrt{\frac{h}{g}}$

18. **B**

Sol. $\ln|R| = \ln|R_0| - \lambda t$

and $T_{1/2} \propto \frac{1}{\lambda}$

where 'N' is slope

$T_{1/2}(A) : T_{1/2}(B) : T_{1/2}(C) = \frac{10}{6} : \frac{5}{6} : \frac{5}{2}$

$= 2 : 1 : 3$

19. **A**

Sol. Power delivered = 1000 W

Voltage = 220 V

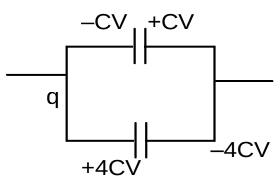
Transmission 'I' = $\frac{1000}{220}$

Power loss = $I^2R$

Efficiency = $\frac{1000 \times 100}{1000 + I^2R}$

20. **A**

Sol. $\frac{4CV - q}{2\ell} = \frac{-CV + q}{c}$ (as same point)




$4cV - q = -2cV + 2q$

$q = 2cV$

Energy = $\frac{(2cv)^2}{4c} + \frac{(cV)^2}{2c} \Rightarrow \frac{3cV^2}{2}$

21. **195.00**

Sol. $\vec{F} = (\hat{i} + 2\hat{j} + 3\hat{k})N$

$\vec{r} = \left((4-1)\hat{i} + (3-2)\hat{j} + (-1-1)\hat{k}\right)$

$\vec{\tau} = \vec{r} \times \vec{F}$

$= \left(3\hat{i} + \hat{j} - 2\hat{k}\right) \times \left(\hat{i} + 2\hat{j} + 3\hat{k}\right)$

$\hat{i} \quad \hat{j} \quad \hat{k}$

$3 \quad 1 - 2 \quad \Rightarrow \quad \hat{i}(3+4) - \hat{j}(11) + (6-1)\hat{k}$

$1 \quad 2 \quad 3 \qquad\qquad 7\hat{i} - 11\hat{j} + 5\hat{k}$

$|\vec{\tau}| = \sqrt{121 + 25 + 49}$

$|\vec{\tau}| = \sqrt{195}$ ; x = 195

22. **51.00**

Sol. $M_o = 200\ \text{MeV}/C^2$, m = 1 Gev/$C^2$

Initial velocity of particle is '$V_o$'.

Final velocity of hydrogen atom is 'V'

$M_oV_o = mV$

$V = \frac{M_oV_o}{m}$ …(1)

Also, $\frac{1}{2}M_0V_0^2 = \frac{1}{2}mV^2 + \frac{3}{4} \times 13.6$

Put (1) and get answer

$\frac{1}{2}M_0V_0^2 = \frac{51}{4}\text{eV}$

Hence, N = 51.

23. **5.00**

Sol. $\vec{B} = \frac{\mu_o I\,(200)}{2R_2}$ $R_2 = 20$ cm ; $R_1 = 1$ cm

$e = -\frac{d\phi}{dt} = \pi(R_1)^2\,(500)\frac{dB}{dt}$

$= \pi(R_1^2)\,(500)\left(\frac{\mu_o I}{2R_2}\right)(200)\,(10t - 2)$

$= \pi\left(\frac{1}{10000}\right)\frac{(500)(200)\,(\mu_o)\,(8)\,(5)}{(2)}$

$= 16\pi^2 \times 10 \times 5 \times 10^{-7}$

$= 800\pi^2 \times 10^{-7}$

e = 0.7887 mv

$\frac{4}{x} = 0.8$ ; x = 5.

24. **50.47**

Sol. We know, $P = \sqrt{2\,Em}$ and $\lambda = \frac{h}{\sqrt{2\,Em}}$ …(1)

For 1st maxima, 2nd sin $\theta = \lambda$

Put (1) and get the answer
E = 50.47 eV.

25. **50.00**

Sol. Image by objective must be at focus of eye piece.

$$\frac{1}{v}-\frac{1}{u}=\frac{1}{f_o}$$

$$\frac{1}{5}-\frac{1}{u}=\frac{1}{1} \quad ; \quad u=-\frac{5}{4}\text{cm}$$

Hence, N = 50.

# PART –B (CHEMISTRY)

26. A

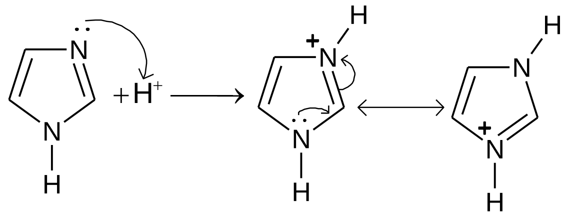
Sol. In solid state $PCl_5$ exists as an ionic solid with constituent ions $PCl_4^+$ (Tetrahedral) and $PCl_6^-$ (Octahedral)

27. C

Sol. According to Aufbau's principal, the increasing energy of atomic orbitals for sixth period element follows the order
6s < 4f < 5d < 6p

28. C

Sol. B is least basic as lone pair of electron is present in resonance so as to make the system aromatic in nature
D is most basic as it results in formation of equivalent resonating structures upon attack of $H^+$
Among A and C, the former is less basic as $sp^2$ hybridistion of nitrogen decrease its basic strength.
Hence option 3 follows

Sol.



29. D

Sol. At CMC, the particles cluster together through lyophobic end to form associated colloid called micelle. Further all lyophilic ends(polar head) get projected towards water.

30. B

Sol. Tyrosine is a non essential amino acid.

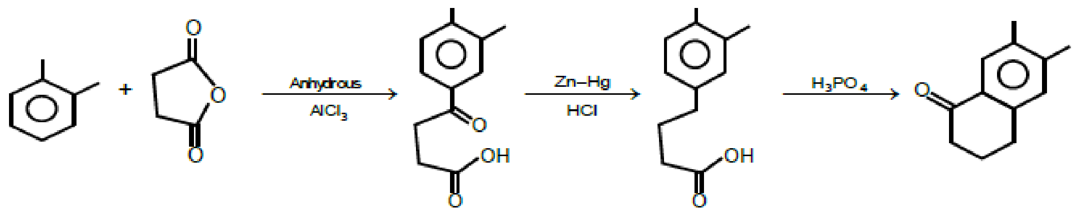
31. C

Sol. For A
$$\frac{0.693}{300} = \frac{2.303}{t}\log\frac{A_0}{A_t}$$
For B
$$\frac{0.693}{180} = \frac{2.303}{t}\log\frac{B_0}{B_t}$$
Given $A_0 = B_0$ & $A_t = 4B_t$
Substituting & solving we get t = 900 s

32. A

Sol. In water gas shift reaction carbon monoxide is oxidized into carbon dioxide by treating it with steam in presence of catalyst.

33. B

Sol.


34. D

Sol. $\rho = \frac{M}{V}$

$\therefore 6.17 = \frac{2}{N_A} \times \frac{M_{X_2}}{\left(300 \times 10^{-10}\right)^3}$

Solving $M_{X_2}$ = 50 g

$\therefore$ No. of molecules in 200 g

$= \frac{200}{50} \times N_A = 4N_A$

35. A

Sol. Among its different uses noradrenaline is used as an anti-depressant.

36. D

Sol. With decrease in inter-nuclear distance, the potential energy of the system decreases, reaches a minimum value and then sharply increases due to rise in inter-electronic as well as inter-nuclear repulsions

37. B

Sol. In endothermic reaction formation of reactants is favoured upon decrease in temperature. Addition of inert gas at constant volume and temperature has no effect on equilibrium.

38. C

Sol. $LiAlH_4$ is a versatile reducing agent which can be used for reduction of cyanide into 1º amine.

39. C

Sol. Esters are susceptible to reaction in basic medium.

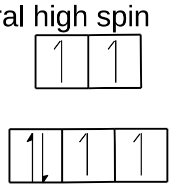
40. C

Sol. Excess of nitrogen and phosphorus is primarily responsible for eutrophication and hence an indicator of polluted environment.

41. C

Sol. Octahedral high spin

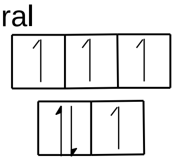
$d^6$



$\therefore$ CFSE = 4(-0.4$\Delta_0$) + 2(0.6$\Delta_0$) = -0.44$\Delta_0$

Tetrahedral

$d^6$



$\therefore$ CFSE = 3(-0.6$\Delta_t$) + 3(0.4$\Delta_t$) = -0.6$\Delta_0$

42. B

Sol. $\Delta R_1 = \frac{a_0}{3}\left(16 - 9\right)$

$\Delta R_2 = \frac{a_0}{2}\left(16 - 9\right)$

$\therefore \frac{\Delta R_1}{\Delta R_2} = \frac{2}{3}$

43. C

Sol. B is the most acidic as it is active methylene group. D is least acidic due to cross-conjugation in conjugate base.

$\therefore$ Option 3 follows

44. A

Sol. Gd : [Xe]$4f^7 5d^1 6s^2$

$\therefore$ $Gd^{3+}$ is [Xe]$4f^7$

Also $\mu = \sqrt{n(n+2)}$ B.M

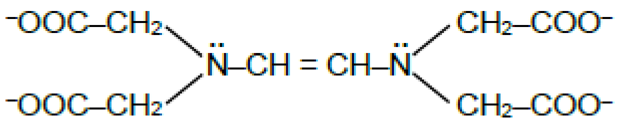
$= \sqrt{7 \times 9}$ B.M $= 7.9$ B.M

45. B

Sol. Ellingham diagram provides information on Gibb's free energy for formation of oxides as a function of temperature.

46. 6

Sol. EDTA as shown is hexadentate



47. 18

Sol. $C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$

$C_4H_{10} + \frac{13}{2}O_2 \longrightarrow 4CO_2 + 5H_2O$

$\because$ 2 mol $C_4H_{10}$ is given

$\therefore$ 13 mol $O_2$ is required for combustion of Butane

$\therefore$ Total mol of $O_2$ = 5 + 13 = 18

48. -6

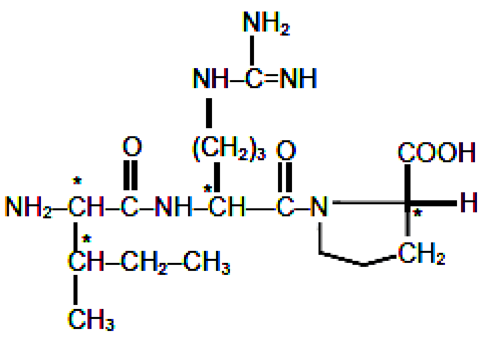
Sol. $\Delta G^0 = -nFE^o$

$\therefore$ $17.37 \times 10^3 = -3 \times 96500 \times E^o$

$\therefore$ $E^o = -6 \times 10^{-2}$ V

49. 4

Sol. The structure of the given compound is as show below



50. 37

Sol. Mass of $CO_2$ dissolve at 3 bar pressure in 1 kg water(which is same as 1 litre since density is 1 gm/mL) = 4.4 gm = 0.1 mol.

For weak electrolytes of Ostwald's dilution law we have pH = ½($pK_a$ – log C)

$\therefore$ pH = ½ [6.4 + 1] = 37 = $37 \times 10^{-1}$

# PART–C (MATHEMATICS)

51. A

Sol. $\therefore$ length of side = 4

then $|z-\bar{z}| = 4$

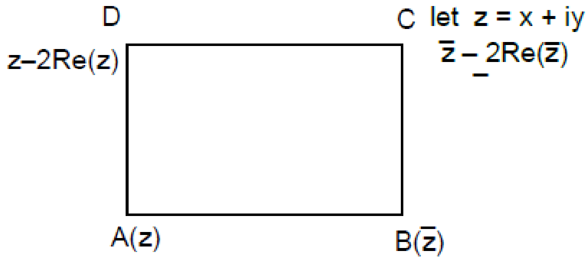
$|2iy| = 4$

$|y| = 2$

also $|z-(z-2\text{Re}(z))| = 4$

$|2x| = 4 \Rightarrow |x| = 2$

$|z| = \sqrt{x^2+y^2} = 2\sqrt{2}$




52. D

Sol. Negation of $x \leftrightarrow \sim y$

$\equiv \sim(x \leftrightarrow \sim y)$

$\equiv x \leftrightarrow \sim(\sim(y))$

$\equiv x \leftrightarrow y$

$\equiv (x \wedge y) \vee (\sim x \wedge \sim y)$

53. D

Sol. $S' = 2^{10} + 2^9.3 + 2^8.3^2 + ........ + 2.3^9 + 3^{10}$

G.P. $\rightarrow$ $a = 2^{10}, r = \frac{3}{2}, n = 11$

$$S' = 2^{10}.\frac{\left(\left(\frac{3}{2}\right)^{11} - 1\right)}{\frac{3}{2} - 1} = 2^{11}\left(\frac{3^{11}}{2^{11}} - 1\right)$$

$= 3^{11} - 2^{11}$

54. B

Sol. Here $D = \begin{vmatrix} 2 & -4 & \lambda \\ 1 & -6 & 1 \\ \lambda & -10 & 4 \end{vmatrix} = (\lambda - 3)(3\lambda + 2)$

$D = 0 \quad \Rightarrow \quad \lambda = 3, -\frac{2}{3}$

$D_1 = \begin{vmatrix} 1 & -4 & \lambda \\ 2 & -6 & 1 \\ 3 & -10 & 4 \end{vmatrix} = 2(3 - \lambda)$

For $\lambda = -\frac{2}{3}, D_1 \neq 0$

55. B

Sol. $I=\int\left(e^{2x}+2e^{x}-e^{-x}-1\right)e^{\left(e^{x}+e^{-x}\right)}dx$

$I=\int\left(e^{2x}+e^{x}-1\right)e^{\left(e^{x}+e^{-x}\right)}dx+\int\left(e^{x}-e^{-x}\right)e^{e^{x}+e^{-x}}dx$

$I=\int\left(e^{x}+1-e^{-x}\right)e^{e^{x}+e^{-x}}dx+e^{x^{e}+e^{-x}}$

$e^{x}+e^{-x}+x=du$

$\left(e^{x}-e^{-x}+1\right)dx=du$

$I=e^{e^{x}+e^{-x}}+e^{e^{x}+e^{-x}}=e^{e^{x}+e^{-x}}\left(e^{x}+1\right)$ then $g(x)=e^{x}+1$

$g(0)=2$

56. C

Sol. a, b, c are in AP then

$2b=a+c$

$28=3^{2\sin2\theta-1}+3^{4-2\sin2\theta}$

Put $3^{2\sin2\theta}=x$

$28=\frac{x}{3}+\frac{81}{x}\Rightarrow x^{2}-84x+243=0$

$(x-3)(x-81)=0$

$3^{2\sin2\theta}=3$ or $3^{4}$

$2\sin2\theta=1$ or $4$

$\sin2\theta=\frac{1}{2}$

terms are 1, 14, 27,…………….then $T_{6}=1+5(13)$

57. D

Sol. $n(C)=73,\qquad n(T)=65,\qquad n(C\cap T)=x$

$n(C\cup T)\le100$

$\Rightarrow\quad n(C)+n(T)-n(C\cap T)\le100$

$\Rightarrow\quad x\ge38$

$n(C\cap T)\le\min(n(C),n(T))\quad\Rightarrow\quad x\le65$

$\Rightarrow\quad 38\le x\le65$

58. B

Sol. $y^{2}=4x$ and $x^{2}=4y$

any tangent of $y^{2}=4x$ is $y=mx+\frac{1}{m}$

it also tangent for $x^{2}=4y$

$\therefore\quad \frac{1}{m}=-m^{2}\Rightarrow\quad m=-1$

$\therefore$ common tangent is $y=-x-1$, it also touches $x^{2}+y^{2}=c^{2}$

$\therefore\quad 1=c^{2}.(1+1)\Rightarrow c^{2}=\frac{1}{2}$

59. D

Sol. $\therefore x^2 = |x|^2 = t$ let

$9t^2 - 18t + 5 = 0$

$(3t-1)(3t-5) = 0$

$|x| = \frac{1}{3}, \frac{5}{3}$

Product of roots $= \frac{1}{3}\left(-\frac{1}{3}\right)\left(\frac{5}{3}\right)\left(\frac{-5}{3}\right) = \frac{25}{81}$

60. B

Sol. $I = \int_{-\pi/2}^{\pi/2} \frac{1}{1+e^{\sin x}} dx . I = \int_{-\pi/2}^{\pi/2} \frac{1}{1+e^{\sin x}} dx$

$I = \int_{-\pi/2}^{\pi/2} \frac{e^{\sin x}}{e^{\sin x}} dx \left\{ \begin{array}{c} \text{Replace} \\ x \to (a+b+x) \end{array} \right.$

$\int_a^b (f(x))dx = \int_c^b f(a+b+x)dx$

$2I = \int_{-\pi/2}^{\pi/2} 1dx \Rightarrow I = \frac{1}{2}\int_{-\pi/2}^{\pi/2} dx$

$I = \frac{1}{2}[x]_{-\pi/2}^{\pi/2} \Rightarrow I = \frac{\pi}{2}$

61. A

Sol. $S = \tan^{-1}\frac{1}{3} + \tan^{-1}\frac{1}{7} + \tan^{-1}\frac{1}{13} + .....$ upto 10 term

$S = \tan^{-1}\left(\frac{2-1}{1+1.2}\right) + \tan^{-1}\left(\frac{3-2}{1+2.3}\right) + \tan^{-1}\left(\frac{4-3}{1+3.4}\right) + ..... + \tan^{-1}\left(\frac{11-10}{1+11.10}\right)$

$S = \left(\tan^{-1}2 - \tan^{-1}1\right) + \left(\tan^{-1}3 - \tan^{-1}2\right) + ...... + \left(\tan^{-1}11 - \tan^{-1}10\right)$

$S = \tan^{-1}11 - \tan^{-1}1$

$S = \tan^{-1}(11) - \frac{\pi}{4}$

$\tan(S) = \frac{5}{6}$

62. C

Sol. $R(-1+2r, 3-2r, -r)$

dr's of PR are $(2-2r, -1+2r, -3+r)$

Then

$2(2-2r) + 2(1-2r) + 1(3-r) = 0$

$9 - 9r = 0 \quad \Rightarrow \quad r = 1$

R (1, 1, –1)

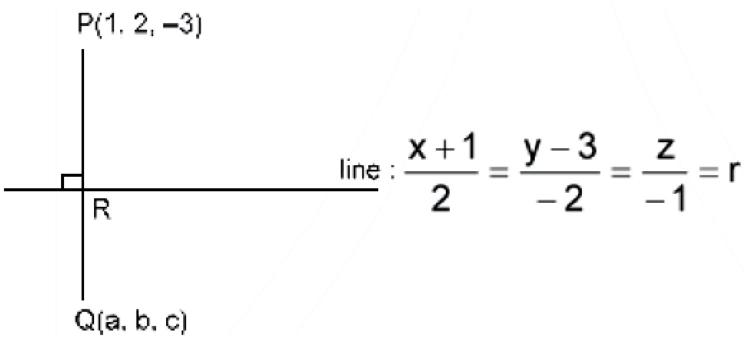
then $a + 1 = 2 \qquad b + 2 = 2$

$c - 3 = -2$

$a = 1 \qquad b = 0$

$c = 1$

$\therefore \quad a + b + c = 2$



63. C

Sol. Given $\frac{dy}{2+y} = \frac{-e^x dx}{5+e^x}$

$\ell n(2+y) = -\ell n(5+e^x) + \ell n C$

$y = \frac{C}{5+e^x} - 2$

$y(0) = 1$ $\therefore$ C = 18

$y = \frac{18}{5+e^x} - 2$

$\therefore$ $y = (\log_e 13) = -1$

64. C

Sol. $P(x) = 0$

$x^2 - x - 2 = 0$

$(x-2)(x+1) = 0$

$x = 2, -1$ $\therefore$ $\alpha = 2$

Now $\lim_{x\to 2^+} \frac{\sqrt{1-\cos(x^2-x-2)}}{x-2}$ $\Rightarrow$ $\lim_{x\to 2^+} \frac{\sqrt{2\sin^2\left(\frac{x^2-x-2}{2}\right)}}{x-2}$

$\Rightarrow$ $\lim_{x\to 2^+} \frac{\left|\sin\left(\frac{x^2-x-2}{2}\right)\right|}{x-2}$ $\Rightarrow$ for $x \to 2^+, \frac{x^2-x-2}{2} \to 0^+$

$\lim_{x\to 2^+} \frac{\sqrt{2}\sin\frac{(x^2-x-2)}{2}}{\left(\frac{x^2-x-2}{2}\right)} \cdot \frac{\frac{x^2-x-2}{2}}{(x-2)}$ $\Rightarrow$ $\lim_{x\to 2^+} \frac{1}{\sqrt{2}} \cdot \frac{(x-2)(x+1)}{(x-2)} = \frac{3}{\sqrt{2}}$

65. A

Sol. For ellipse $\frac{x^2}{16} + \frac{y^2}{9} = 1$, $a = 4$, $b = 3$, $e = \sqrt{1 - \frac{9}{16}} = \frac{\sqrt{7}}{4}$

A and B are foci then $PA + PB = 2a = 2(4) = 8$

66. D

Sol. f(x) is differentiable then will also continuous then $f(\pi) = -1, f(\pi^{+1}) = -k_2$

$k_2 = 1$

Now $f'(x) = \begin{cases} 2k_1(x-\pi) & x \le \pi \\ -k_2 \sin x & x > \pi \end{cases}$ then $f'(\pi^-) = f'(\pi^+) = 0$

$f''(x) = \begin{cases} 2k_1 & x \le \pi \\ -k_2 \cos x & x > \pi \end{cases}$ then $2k_1 = k_2$

$k_1 = \frac{1}{2}$

67. D

Sol. $C_3 \to C_2 - C_1$

$$f(\theta) = \begin{vmatrix} -\sin^2\theta & -1 & 1 \\ -\cos^2\theta & -1 & 1 \\ 12 & -2 & -2 \end{vmatrix} = 4\left(\cos^2\theta - \sin^2\theta\right) = 4(\cos 2\theta), \theta \in \left[\frac{\pi}{4}, \frac{\pi}{2}\right]$$

$f(\theta)_{max} = M = 0$

$f(\theta)_{min} = m = -4$

68. A

Sol. $\bar{x} = \frac{2+4+10+12+14+x+y}{7} = 8$

$\Rightarrow \quad 42 + x + y = 56 \qquad \Rightarrow \quad x + y = 14$

$$\sigma^2 = \frac{\sum x_i^2}{n} - \left(\frac{\sum x_i}{n}\right)^2$$

$$16 = \frac{4+16+100+144+196+x^2+y^2}{7} - (8)^2$$

$\Rightarrow \quad 16 + 64 = \frac{460 + x^2 + y^2}{7}$

$\Rightarrow \quad 560 = 460 + x^2 + y^2 \qquad \Rightarrow \quad x^2 + y^2 = 100 \qquad \ldots\ldots\ldots(2)$

$\Rightarrow \quad xy = 48$

$(x-y)^2 = (x+y)^2 - 4xy = 4$

$|x-y| = 2$

69. C

Sol. Equation $\frac{x^2}{5} + \frac{y^2}{4} = 1$ then $P\left(\sqrt{5}\cos\theta, 2\sin\theta\right)$

$(PQ)^2 = 5\cos^2\theta + 4(\sin\theta + 2)^2 = \cos^2\theta + 16\sin\theta + 20$

$= -\sin^2\theta + 16\sin\theta + 21$

$= 85 - (\sin\theta - 8)^2$

$= (PQ)^2_{max} = 85 - 49 = 36,$

$\because \quad (\sin\theta - 8)^2 \in [49, 81]$

70. C

Sol. Volume of parallelepiped $v = \left|\left[\vec{a} \;\; \vec{b} \;\; \vec{c}\right]\right|$

$$v = \begin{vmatrix} 1 & 1 & n \\ 2 & 4 & -n \\ 1 & n & 3 \end{vmatrix} = \pm 158$$

$1\left(12+n^2\right)-1(6+n)+n(2n-4)=\pm 158$

$3n^2-5n-152=0$ or $3n^2-5n+164=0$

$D<0$ (no real roots)

$n=8,-\frac{19}{3} \Rightarrow$ n = 8

then $\vec{b}.\vec{c}=2+4n-3n=10$

$\vec{a}.\vec{c}=1+n+3n=33$

71. 13.00

Sol. $T_{r+1}={}^{22}C_r\left(x^m\right)^{22-r}x^{-2r}$

$T_{r+1}={}^{22}C_r\,x^{m(22-r)-2r}$

$22m-mr-2r=1$

$22m-1=r(m+2)$

$r=\frac{22m-1}{m+2}$

$r=\frac{22m+44-45}{m+2}$

$r=22-\frac{3.3.5}{m+2}$

So possible value of m = 1, 3, 7, 13, 43

but ${}^{20}C_r=1540$

only possible condition is m = 13

72. 08.00

Sol. $-5<\frac{x}{2}<5$

$I \Rightarrow \left[\frac{x}{2}\right]=-5,-4,-3,-2,-1,0,1,2,3,4$

Hence, function is discontinues at = –4, –3, –2, –1, 1, 2, 3, 4

Number of values is 8.

73. 30.00

Sol. $2x-y+3=0$ ……….(i)

$4x-2y+\alpha=0 \Rightarrow 2x-y+\frac{\alpha}{2}=0$ …………(ii)

$6x-3y+\beta \Rightarrow 2x-y+\frac{\beta}{3}=0$ ………..(iii)

$d_1=\frac{\left|\frac{\alpha}{2}-3\right|}{\sqrt{2^2+1^2}}=\frac{1}{\sqrt{5}} \Rightarrow |\alpha-6|=2 \Rightarrow \alpha-6=2,-2 \Rightarrow \alpha=8,4$

$d_2=\frac{\left|\frac{\beta}{3}-3\right|}{\sqrt{2^2+1^2}}=\frac{2}{\sqrt{5}} \Rightarrow |\beta-9|=6 \Rightarrow \beta-9=6,-6 \Rightarrow \beta=15,3$

Sum of all value of $\alpha$ and $\beta=30$.

74. 11.00

Sol. P (at least 2 show 3 or 5) $= {}^4C_2 . \left(\frac{2}{6}\right)^2 \left(\frac{4}{6}\right)^2 + {}^4C_3 \left(\frac{2}{6}\right)^3 \left(\frac{4}{6}\right) + {}^4C_4 \left(\frac{2}{6}\right)^4$

$= \frac{384 + 128 + 16}{6^4} = \frac{11}{27}$

n = 27

$\therefore$ expectation of number of times = np

$= 27 . \frac{11}{27} = 11$

75. 240.00

Sol. SYLLABUS

S – 2, L – 2, A, B, Y, U

Required $= {}^2C_1 . {}^5C_2 . \frac{4!}{2!} = 2.10. \frac{24}{2} = 240$